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# SOME NEW AND OLD SPECIES OF THE PRIMNOID GENUS *CALLOGORGIA* GRAY, WITH A REVALIDATION OF THE RELATED GENUS *FANELLIA* GRAY (COELENTERATA: ANTHOZOA)

Frederick M. Bayer

*Abstract.*—One new and three previously known species of *Callogorgia* Gray are described and illustrated by scanning electron microscopy. The diagnostic characters of the genus are discussed and the species divided between two genera, for the second of which Gray's generic name *Fanellia* is restored to validity. Keys to the species of both (exclusive of the Atlantic and Mediterranean) are provided.

## Introduction

In the course of reviewing the genera of Gorgonacea, it was found that the species traditionally assigned to the genus *Callogorgia* (Family Primnoidae) fall into two separate groups on the basis of external skeletal ornamentation, loosely correlated with colonial growth form. Typical *Callogorgia,* based upon *Gorgonia verticillata* Pallas, has pinnate growth form and sclerites varying from externally smooth to granulated or wrinkled, in a few species with the abaxial scales sculptured by prominent radial crests derived from the marginal ridges of the inner rim. A second group of species has dichotomous branching (or pinnate branching so lax that it may appear dichotomous, which is here called 'quasi-dichotomous') and sclerites with crowded, radially oriented tubercles extensively coalesced as ridges. This group of species is now restored to generic status under the name *Fanellia,* proposed for *Primnoa compressa* Verrill by J. E. Gray (1870:46). This genus as now constituted occurs from the Bering Sea and Gulf of Alaska south and west to Hawaii and New Caledonia, across the Pacific to Japan and Indonesia. It is not known from the eastern Pacific, from either side of the Atlantic or from the Mediterranean, and has not been reported from the Indian Ocean. Species of *Callogorgia* occur in the Mediterranean Sea, on both sides of the Atlantic Ocean, from the west coast of the Americas westward to Indonesia, and throughout most of the Indian Ocean. The few *Callogorgia* species reported from the Southern Ocean (*C. antarctica, C. kuekenthali, C. nodosa* and possibly *C. ventilabrum*), all with dichotomous growth form, are referable to still another genus, *Ascolepis* Thomson and Rennet, having sculpture completely different from that of *Fanellia.*

## Methods

The Scanning Electron Micrographs (SEM) of intact polyps were made with a Cambridge Stereoscan model S4-10, and the sclerites were examined and photographed with a Coates and Welter model 106 field-emission instrument.

For examination by SEM, sclerites were dissociated and cleaned of surrounding tissues by commercial 5.25% sodium hypochlorite bleach, followed by weak (3%)

hydrogen peroxide and thorough washing in water. After a rinse in 100% ethanol, the bulk sample was dried and subjected to an oxygen plasma for about 4 hours, before mounting with PVA emulsion adhesive on 10-mm coverglasses that can be affixed to standard Cambridge SEM stubs, or held in a custom-made spring-clip holder compatible with the Cambridge stage. Specimens were precoated with carbon and sputter-coated with gold/palladium.

Samples for examination as whole mounts were selected for undamaged condition using a conventional stereomicroscope. After removal of superficial tissue by a very brief immersion in sodium hypochlorite solution followed by hydrogen peroxide and thorough rinsing in 70% ethanol, air-dried samples of suitable length (no more than 2 cm) were mounted vertically in the center of standard Cambridge stubs by means of PVA emulsion adhesive. After appropriate coating with carbon and gold/palladium, these preparations were placed in the Cambridge series 200 microanalytical stage using an adapter specially made to accommodate the standard Cambridge stub. The smaller Cambridge series 100 stage will not accept samples of this size. The stage was tilted to a full 90° for examination of such wholemounts, and stereo pairs prepared by rotation (8°) rather than by tilting, in order to preserve the original orientation more closely.

## Taxonomic Characters

The principal characters available for the classification and identification of primnoids are:

1 Colonial form and manner of branching.
2 Size and arrangement of polyps.
3 Number, arrangement, form and ornamentation of sclerites on the polyps and, to a lesser extent, on the coenenchyme.

*Colonial form.*—Although "pinnate" and "dichotomous" branching have been employed as key characters, the two forms intergrade, and where they do so they are ambiguous. In true pinnate growth form, only branches of the first order are produced; the first-order branchlets are terminal "pinnae" that rarely subdivide, except to produce a lateral plume that is structurally identical to the main one. In the dichotomous growth form, branching proceeds to several orders, each branch repeatedly forking into two. If the first-order branchlets in a pinnate colony are widely spaced and are not consistently "terminal" but produce second- and third-order branchlets, the branching pattern simulates dichotomy. This condition is illustrated in Figs. 15 and 18, and is here called "quasi-dichotomous."

*Size and arrangement of polyps.*—The distribution of polyps in the colony appears to be a consistent character at generic and specific levels. The verticillate arrangement is common in the family and, in genera such as *Primnoella, Calyptrophora,* and *Narella,* is never departed from. In all known species of *Callogorgia* save one, the polyps are in whorls, and the one exception differs in so many other regards that it probably does not belong in *Callogorgia* at all. In *Plumarella,* the polyps may be arranged either in tight spirals all around the branchlets, or biserially (but not in opposite pairs, which really are "whorls" of two). In *Thouarella,* various species are described with polyps paired, in whorls,

and in loose, irregular spirals even within one subgenus of this large and perplexing genus. It is probable that when all the species have been reviewed in modern terms, a generic realignment in which the arrangement and spiculation of the polyps is more consistent will emerge.

The direction in which the polyps face is quite consistent. Except in the genus *Primnoa,* polyps face upward in all genera in which they are not in whorls; the polyps of *Primnoa* face downward, apart from occasional strays. In *Primnoella, Callogorgia,* and *Fanellia* they always face upward, again except for strays (which may be induced by the presence of epizoites, such as echinoderms). In *Calyptrophora* they always face upward, in *Paracalyptrophora, Arthrogorgia,* and *Narella* always downward, and in *Candidella, Parastenella, Pterostenella,* and the verticillate species of *Thouarella,* directly outward or slightly upward.

*Sclerites.*—Although irregular tuberculate rods and spindles occur in the Primnoidae and may be the original sclerite form in this family, they are of only sporadic occurrence and the predominant forms are flat scales or plates, sometimes very thick. On the body of the polyps, these scales are basically arranged in 8 longitudinal rows as well as in transverse circlets, of which the uppermost constitutes in most genera an operculum of 8 triangular scales distinctly differentiated from the rest of the body scales below them. The sizes and shapes of the sclerites are influenced by the extent of inward curvature achieved by the polyps during contraction. A special terminology of sclerites in various positions on the polyps has developed over the years, differing even from genus to genus, depending upon the degree of modification that the skeletal armature has undergone. Because these terms are generally used in keys and taxonomic descriptions, those applicable to forms with strongly in-turned polyps, such as *Callogorgia,* are briefly explained.

Because of the inward curvature of the polyps, those rows on the side of the body turned toward the axis are called *adaxial,* those on the side facing outward *abaxial,* and the intermediate ones *outer lateral* and *inner lateral.* Owing to the bilateral symmetry of the octocoral polyp, the scale rows are paired, so the members of the pairs lie on opposite sides of the body, with the "sagittal" plane passing between the members of the abaxial and adaxial scale rows. The scales of the transverse circlet immediately below and surrounding the opercular are termed *marginal,* but no special terminology applies to those below. To save space in print, the scale rows are designated by abbreviations (Abax = abaxial; OL = outer lateral; IL = inner lateral; Adax = adaxial) and the individual scales are numbered from the operculum downward, as shown in Fig. 1.

In *Callogorgia* the outer surface of the sclerites may be smooth, wrinkled, or ornamented by sharp granules often aligned in radial or reticulating rows (see Figs. 9, 10). The inner surface of the body scales always has a more or less smooth distal margin marked by radial ridges that may be low, or high and crest-like, throwing the edge into dentations (see Figs. 7, 8), and sometimes extending outward as tall crests on the distal outer surface of the scales (see Figs. 2–5).

In *Fanellia* the outer surface is covered by crowded, fluted or serrated tubercles commonly coalescing to form radial ridges (see Figs. 13, 14; 16, 17; 19–22; 25, 26; 28, 29). In both genera, the central inner surface of all scales is covered by crowded, complex tubercles that serve to anchor the sclerites in the mesogloea.

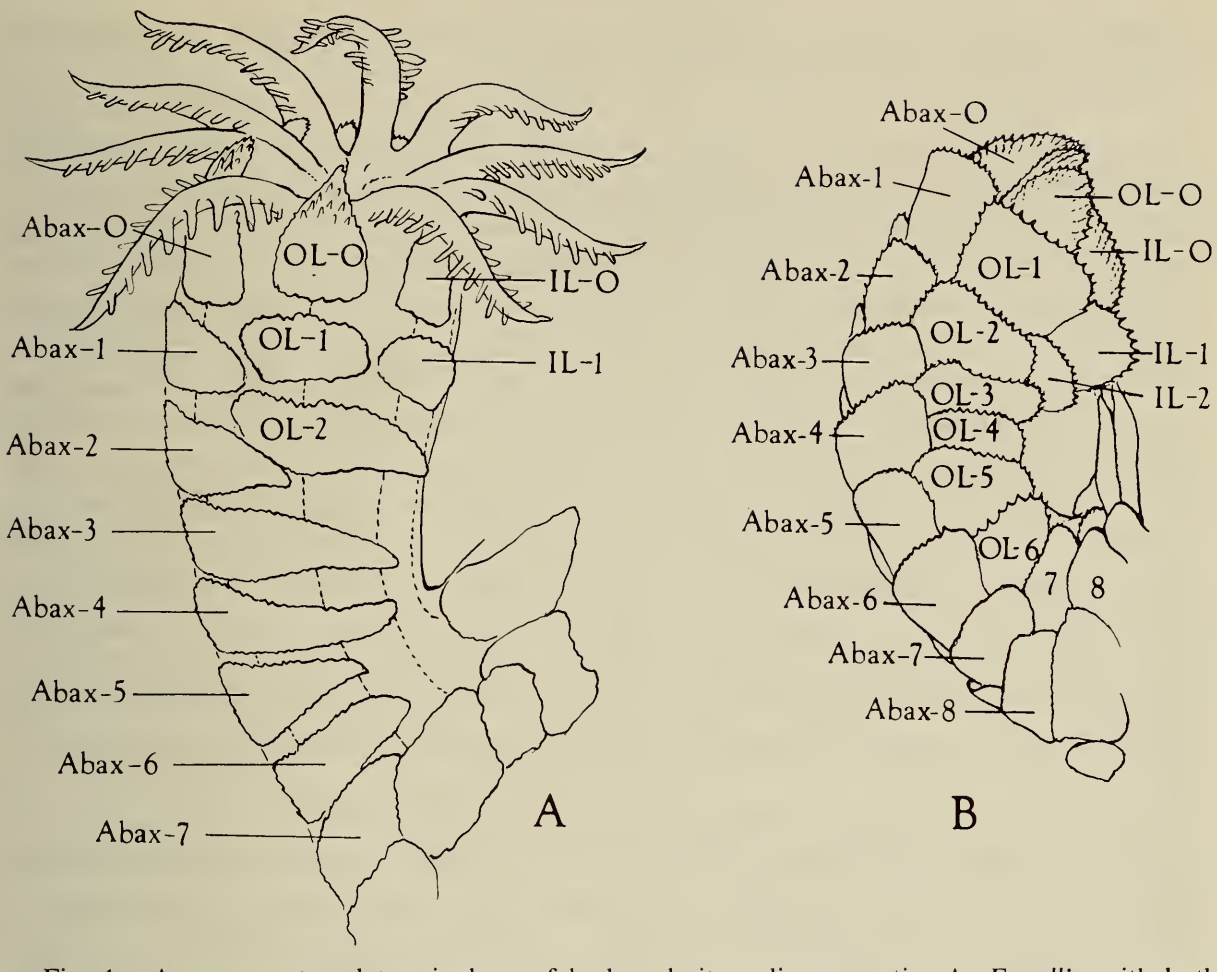


Fig. 1. Arrangement and terminology of body sclerites, diagrammatic: A, *Fanellia* with both outer-lateral and inner-lateral rows reduced in number; B, *Callogorgia* with outer-lateral rows well developed, inner laterals reduced. Abax = abaxial; OL = outer lateral; IL = inner lateral; Adax = adaxial (not visible in side view). O = opercular scale; 1 = marginal; 2— = remaining body scales numbered proximad.

## *Callogorgia* Gray, 1858

*Gorgonia*.—Pallas, 1766:160 (part).—Linnaeus, 1767:1289 (part).—Ellis and Solander, 1786:67 (part).

*Muricea*.—Dana, 1846:675 (part).

*Prymnoa*.—Ehrenberg, 1834:357 (part).

*Primnoa*.—Milne Edwards and Haime, 1857:139 (part).—von Koch, 1878:457; 1887:85.

*Callogorgia* Gray, 1857 [1858]:286 (type-species, *Gorgonia verticillata* Pallas, 1766, by monotypy).—Bayer, 1961 [1962]:296 (part).—Carpine and Grasshoff, 1975:102.

*Calligorgia* Gray, 1870:35 (unjustified emendation).—Studer, 1878:51.

*Xiphocella* Gray, 1870:56 (type-species, *Gorgonia verticillata*: *sensu* Esper, 1797:156, by monotypy).

? *Callicella* Gray, 1870:37 (type-species, *Callicella elegans* Gray, 1870, by monotypy).

*Caligorgia* Wright and Studer, 1889:75 (unjustified emendation).—Versluys, 1906:55.—Kükenthal and Gorzawsky, 1908:19.—Kinoshita, 1908:34.—Nutting,

1908:574.—Kükenthal, 1912:320(?); 1915:146; 1919:362; 1924:267.—Deichmann, 1936:158.

*Description.*—Colonies of moderate (30 cm) or large (over 1 m) size, branched in one plane, pinnate, with branchlets usually alternating, rarely opposite (1 species), new branchlets originating only apically, not between pre-existing branchlets, sometimes openly pinnate or quasi-dichotomous, rarely dichotomous (1 species?). Polyps in whorls of 3–6 or more, directed toward apex of branches, in some species beginning distally as pairs and increasing in numbers proximad, bent inward toward the axis, the adaxial side more or less closely appressed to the axial coenenchyme. Sclerites of the polyps in the form of scales curved to conform with the contours of the body, placed in longitudinal rows of which only the two abaxials are complete, the lateral and adaxial rows with reduced numbers of scales, in some species absent adaxially except for the operculars. Opercular scales triangular, shape abruptly different from those of marginals, which do not fold inward over the operculars. Tentacles without sclerites in most species, a few with minute rods. Coenenchymal sclerites in the form of plates, from broadly polygonal or ovate to strongly elongate. Axis heavily calcified, irregularly grooved longitudinally, yellowish, brownish or greyish, often with metallic or iridescent sheen.

*Discussion.*—This genus, established by J. E. Gray (1858) for the eastern Atlantic and Mediterranean *Gorgonia verticillata* Pallas, 1766, is widespread and, apart from some trans-Atlantic confusion of the type-species (see Carpine 1963:30; Carpine and Grasshoff 1975:102), has been comparatively free of problems. However, a number of species have been ascribed to it erroneously, and examination of a wide array of species reveals that they fall into rather well-defined groups on the basis of spicular ornamentation.

Kükenthal (1924:267) characterized the genus as follows (translation mine): Colonies abundantly branched and mostly in one plane, sometimes pinnate with alternate or opposite terminal branchlets, sometimes more dichotomous. The polyps occur in whorls, only on the larger stems scattered as well. Their adaxial wall is more or less naked. The scales of the polyps are set in longitudinal rows, of which the adaxials are always reduced; they are mostly strong and conspicuous, beset on the inner surface with numerous closely placed small warts, on the outer surface mostly with thornlike projecting ridges or other sculpture. The opercular scales are well developed abaxially and distinctly pointed, becoming smaller adaxially. The marginal scales do not overreach the operculars and are not movable inward. The coenenchymal scales are unlike those of the polyps, not imbricated but set side by side and mostly quite thick, commonly elongated.

It is clear from published descriptions that *Caligorgia antarctica* Kükenthal (1912:321), *Caligorgia nodosa* Molander (1929:60), and *Caligorgia ventilabrum* Studer *sensu* Gravier (1914:85) actually belong to *Ascolepis* Thomson and Rennet (1931:20), which I regard as a valid genus (Bayer 1981:936). The growth form of all of these species is quite unlike the pinnate colonies of most species of *Callogorgia*.

Versluys (1906:83), in his exemplary monograph on the Primnoidae of the Siboga Expedition, recognized that the species of *Callogorgia* reviewed by him fall into groups. Unfortunately, he grouped the species first on the basis of branching,

which, as can be seen in other genera of Primnoidae, is an unreliable character, partly because it is difficult to distinguish pinnate branching, if widely spaced, from dichotomous, and partly because both "pinnate" and "dichotomous" branching can occur in a single genus.

However, among the dichotomously branched species, Versluys (1906:84) clearly recognized the distinctively different kind of sculpturing characteristic of the sclerites of *C. compressa* and *C. tuberculata*. The subsequent description of two other species (*C. granulosa, C. aspera*) from Japan by Kinoshita (1907, 1908a) and one from the Marshall Islands by me (Bayer 1949:207), together with the discovery among the *Albatross* Philippine octocorals of yet another species, all with the same kind of external ornamentation, makes it clear that this character, not the colonial growth form, provides a reliable basis for grouping of species. Further, neither in the literature nor among the specimens examined have I found any examples of sculpture intermediate between the tuberculata-compressa type and the verticillata-flabellum type. Consequently, these two groups are discontinuous and merit full generic rank. A new generic name is not required for the tuberculata-compressa complex as Gray (1870:46) already has proposed for *C. compressa* Verrill a nominal genus *Fanellia,* which is here restored to good standing.

Although the remaining species of *Callogorgia* have generally similar sculpture, two sub-types can be recognized among them: (1) those with the scales more or less smooth externally, sculptured at most by smooth granules, usually scattered but sometimes merging to form wrinkles that may anastomose into reticular ornamentation (*sertosa* Wright and Studer, *verticillata* Pallas, *grimaldii* Studer, *pennacea* Versluys, *joubini* Versluys, *similis* Versluys, *minuta* Versluys, *affinis* Versluys, *kinoshitae* Kükenthal, *gilberti* Nutting, *ventilabrum* Studer, *gracilis* Milne Edwards and Haime); and (2) those with the body scales sculptured externally by prominent radial crests that are outward extensions of the radial ridges developed around the inner distal margin of the body scales in most species, if not all (*flabellum* Ehrenberg, *weltneri* Versluys, *robusta* Versluys, *cristata* Aurivillius, *verticillata sensu* Deichmann). Even though these two kinds of sculpture are usually quite distinct, there is some overlap. In some (but not all) specimens of *C. gracilis* (Milne Edwards and Haime), the inner marginal ridges of the abaxial marginal scales are reflected outward onto the outer surface as low ridges converging toward the nucleus of the scale. These ridges have a quite different aspect from those of *C. flabellum* and related forms (*robusta, weltneri, cristata*), but they seem to be identical structurally. Therefore, there seems to be no infallible basis for subdividing those species into two genera, or even subgenera.

The disposition of *Ascolepis* Thomson and Rennet, 1931, is equivocal. Both of the original species, *A. splendens* and *A. spinosa,* have sclerites of unusual form—not so distinctly cuplike as originally described and illustrated from observation with the light microscope, but certainly with a concave outer part more or less clearly set off from a tuberculated base. The same is true of *Caligorgia nodosa* Molander and the specimens reported as *C. ventilabrum* by Gravier, appears to be true also of *C. antarctica* Kükenthal, and could be true of *C. kükenthali* Molander. If *C. antarctica* represents an intermediate between *Callogorgia* and *Ascolepis*, thus making the latter a junior synonym, then the genus *Callogorgia* will include species that do not remotely resemble the majority of species of *Callogorgia*. Because of the difficulty in defining *Callogorgia* that

would result from merging *Ascolepis* with it, the preferable course is to maintain both as distinct.

Other problems with the definition of *Callogorgia* remain to be solved, notably the case of those Antarctic species of *C. antarctica* growth form in which the regular alignment of abaxial and lateral body scales is completely disrupted. Whether these merit separate recognition, or must be accommodated in a more broadly defined genus *Callogorgia* is a question that must await further study. For the time being, I propose to recognize *Callogorgia, Fanellia,* and *Ascolepis* as separate genera.

## Key to Indo-Pacific Species of *Callogorgia*[1]

1(20). Branching typically pinnate.
2(3). Branches strictly opposite ..... *C. formosa* Kükenthal, 1907
3(2). Branches alternate.
4(7). Outer-lateral scale-rows well developed.
5(6). Polyps 1.3–1.5 mm tall, whorls separated by conspicuous intervals, 5 in 1 cm ..... *C. sertosa* Wright and Studer, 1889
6(5). Polyps larger, up to 2 mm tall, whorls closely placed, 5 in 1 cm ... ..... *C. kinoshitae* Kükenthal, 1913
7(4). Scales in outer lateral rows sharply reduced in number.
8(19). Operculum tall and prominent.
9(16). Apex of opercular scales with a single point.
10(13). 10 scales in each abaxial row.
11(12). Apex of opercular scales prolonged into a rodlike point ..... ..... *C. ramosa* Kükenthal & Gorzawsky, 1908
12(11). Apex of opercular scales not prolonged into a rodlike point ..... ..... *C. flabellum* (Ehrenberg, 1834)
13(10). 6–7 scales in each abaxial row.
14(15). Polyps 2 mm tall ..... *C. robusta* Versluys, 1906
15(14). Polyps 1 mm tall ..... *C. joubinii* Versluys, 1906
16(9). Abaxial opercular scales with 2–4 apical points.
17(18). 5–6 whorls of polyps in 1 cm; 8–10 scales in abaxial rows; no inner lateral scales ..... *C. cristata* Aurivillius, 1931
18(17). 4–5 whorls of polyps in 1 cm; 7 scales in abaxial rows; 1 inner-lateral scale ..... *C. weltneri* Versluys, 1906
19(8). Operculum low ..... *C. pennacea* Versluys, 1906
20(1). Branching dichotomous or quasi-dichotomous.
21(26). Outer-lateral scale rows well developed.
22(23). 8 scales in each abaxial row ..... *C. ventilabrum* Studer, 1878
23(24). 9 scales in each abaxial row *C. laevis* Thomson and Mackinnon, 1911[2]
24(25). 10 scales in each abaxial row ..... *C. versluysi* Thomson, 1905
25(22). 12–13 scales in each abaxial row ..... *C. elegans* (Gray, 1870)
26(21). Scales in outer lateral rows reduced in number.
27(28). 3 scales in each outer-lateral row ..... *C. indica* Versluys, 1906

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[1] Modified from Kükenthal (1919).

[2] Examination of the type-specimens in the Australian Museum since this manuscript went to press has enabled me to determine that this species does not belong to *Callogorgia* but to *Primnoella.*

28(27). 1 or 2 scales in each outer-lateral row.
29(32). 5 scales in each abaxial row.
30(31). 2–3 polyps per whorl, rarely 4; 8–9 whorls in 1 cm; body scales with low marginal ridges ..... *C. minuta* Versluys, 1906
31(30). 3–4 polyps per whorl, sometimes 5; 9–11 whorls in 1 cm; body scales with distal margins strongly reflexed, exposing high crestlike ridges ..... *C. chariessa,* n. sp.
32(29). 7 scales in each abaxial row.
33(34). Body scales with strong marginal ridges; 4–5 polyps in each whorl, 9–10 whorls in 1 cm ..... *C. affinis* Versluys, 1906
34(33). Body scales with weak marginal ridges; 2, usually 3 polyps in each whorl, 7–8 whorls in 1 cm ..... *C. similis* Versluys, 1906

## *Callogorgia flabellum* (Ehrenberg)
Figs. 2, 3

*Prymnoa flabellum* Ehrenberg, 1834:358 (locality not given).
*Caligorgia flabellum.*—Versluys, 1906:69, figs. 75–78, pl. 5, fig. 13, pl. 6, fig. 14 (Kei Islands, 5°28.4′S, 132°0.2′E, 204 m).
not *Caligorgia flabellum.*—Nutting, 1912:60 (=*C. aspera* Kinoshita, 1908a = *C. tuberculata* Versluys, 1906).

*Material examined.*—Moluccas, off Makian, west of Halmahera, 0°15′00″N, 127°24′35″E, 545 m, sand and coral, *Albatross* sta. D5621, 28 November 1909: several large branches without base, and smaller detached branches, USNM 57545 (Figs. 2, 3).

*Description.*—See Versluys, 1906:69.

*Discussion.*—As Versluys (1906:69) has given a full description of the *Siboga* material, description of the present material would be superfluous. However, the validity of Versluys's identification of the *Siboga* material rests solely on his own comparison with a badly preserved fragment of Ehrenberg's type in the Berlin Museum, as Wright and Studer did not compare the Challenger specimen with Ehrenberg's type as Versluys thought (1906:71), but with Gray's type of *Callicella elegans* (Wright and Studer, 1889:79).

The specimen taken by the *Albatross* off Makian, west of Halmahera in the Moluccas, agrees satisfactorily with Versluys's account of the *Siboga* specimens from the Kei Islands. The characters that are diagnostically important are: 8–10 abaxial scales in each row, with strong radial ridges extending from the inner marginal ridges; 3 outer laterals, 2 inner laterals, 1 adaxial; operculars tall, tapered to a single blunt point; abaxial scales sculptured with strong radial crests that extend distally as marginal serrations, most prominent on the distal sclerites, decreasing in strength proximad until on the basalmost one or two they are reduced to low ridges or merely conspicuous wrinkles. The cortical plates are irregularly elongate, commonly with a central outer projection and crowded, pointed tubercles that are more or less extensively joined to form irregularly meandering low ridges or wrinkles.

The present material differs from Versluys's description to a small degree, which records 2 outer laterals and 1 inner lateral but, in fact, his drawing (Fig. 85) suggests 3 outer laterals and 2 inner laterals, as is usually the case in the

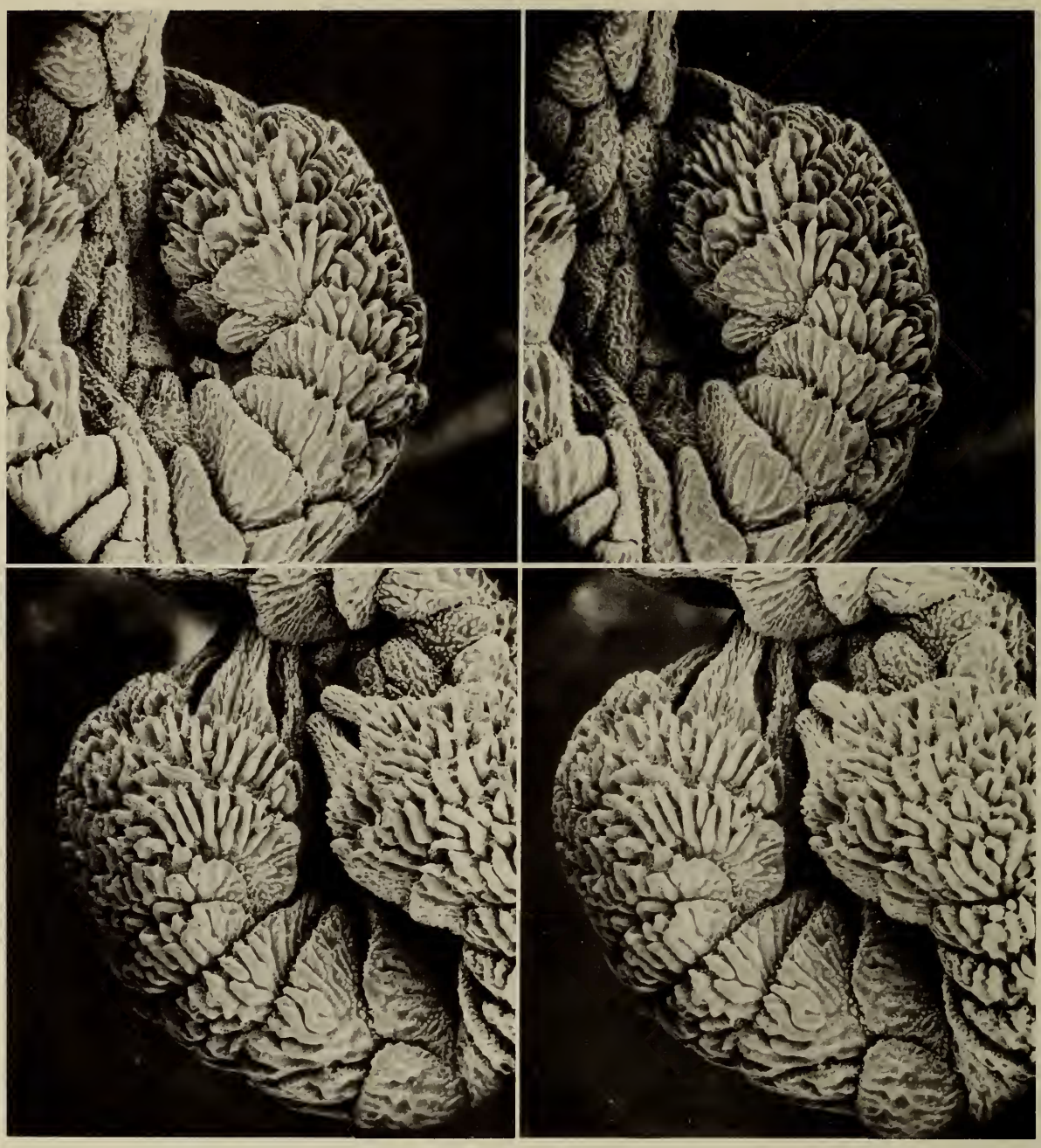


Fig. 2. *Callogorgia flabellum* (Ehrenberg), USNM 57545: left and right lateral views of polyp. SEM stereo pairs, ×40.

specimen before me. As can be seen from the accompanying SEM photos (Fig. 2), the sculpture of the body scales obscures the distinction between individual scales and renders counting and drawing by camera lucida uncertain. The shapes and positions of scales shown in Versluys's drawing make it difficult to interpret the scales labeled 'G' as outer laterals. Their location requires them to be inner laterals, hence 2 in number, so the adaxial part of the 3 distalmost abaxial scales can only be 3 outer laterals.

*Callogorgia flabellum* is very similar to *C. cristata* in aspect, difficult to distinguish with the dissecting microscope. The most reliable recognition features are: (1) the presence of 3 OL, 2 IL, and 1 Adax; (2) the single points on the abaxial operculars; (3) the extension of the inner marginal ridges of the abaxial

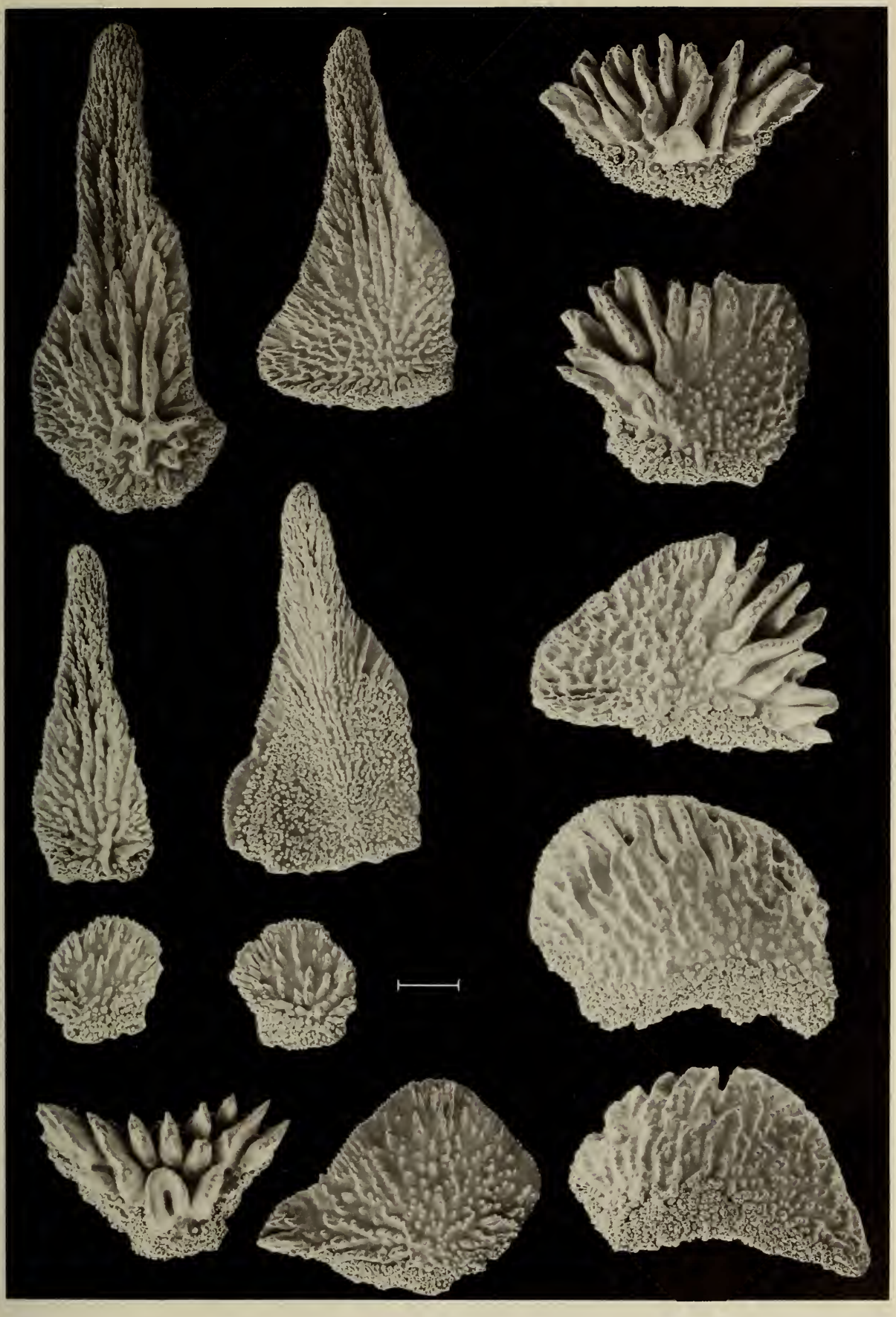


Fig. 3. *Callogorgia flabellum* (Ehrenberg), USNM 57545: opercular, adaxial marginal, abaxial, outer-lateral sclerites of polyp. Scale = 0.1 mm.

Fig. 4. *Callogorgia cristata* Aurivillius. Top, USNM 57544; bottom, USNM 44179, part of type in Zoological Museum, University of Uppsala: intact whorls of polyps. SEM stereo pairs, ×27.

scales onto the outer surface as strong radial crests; and (4) the persistence of external sculpture, though reduced, on the proximal abaxial scales.

*Callogorgia cristata* Aurivillius
Figs. 4, 5

?*Caligorgia weltneri* Versluys, 1906:73, figs. 80–82, pl. 4, fig. 10 (southwest of Waigeu, between Jef Fam and Gagi, 0°29.2′S, 130°05.3′E, 469 m).—Kükenthal, 1924:274.

*Caligorgia cristata* Aurivillius, 1931:262, fig. 52, pl. 6, fig. 1 (Japan, Goto Is., west of Kyushu, 160 m).

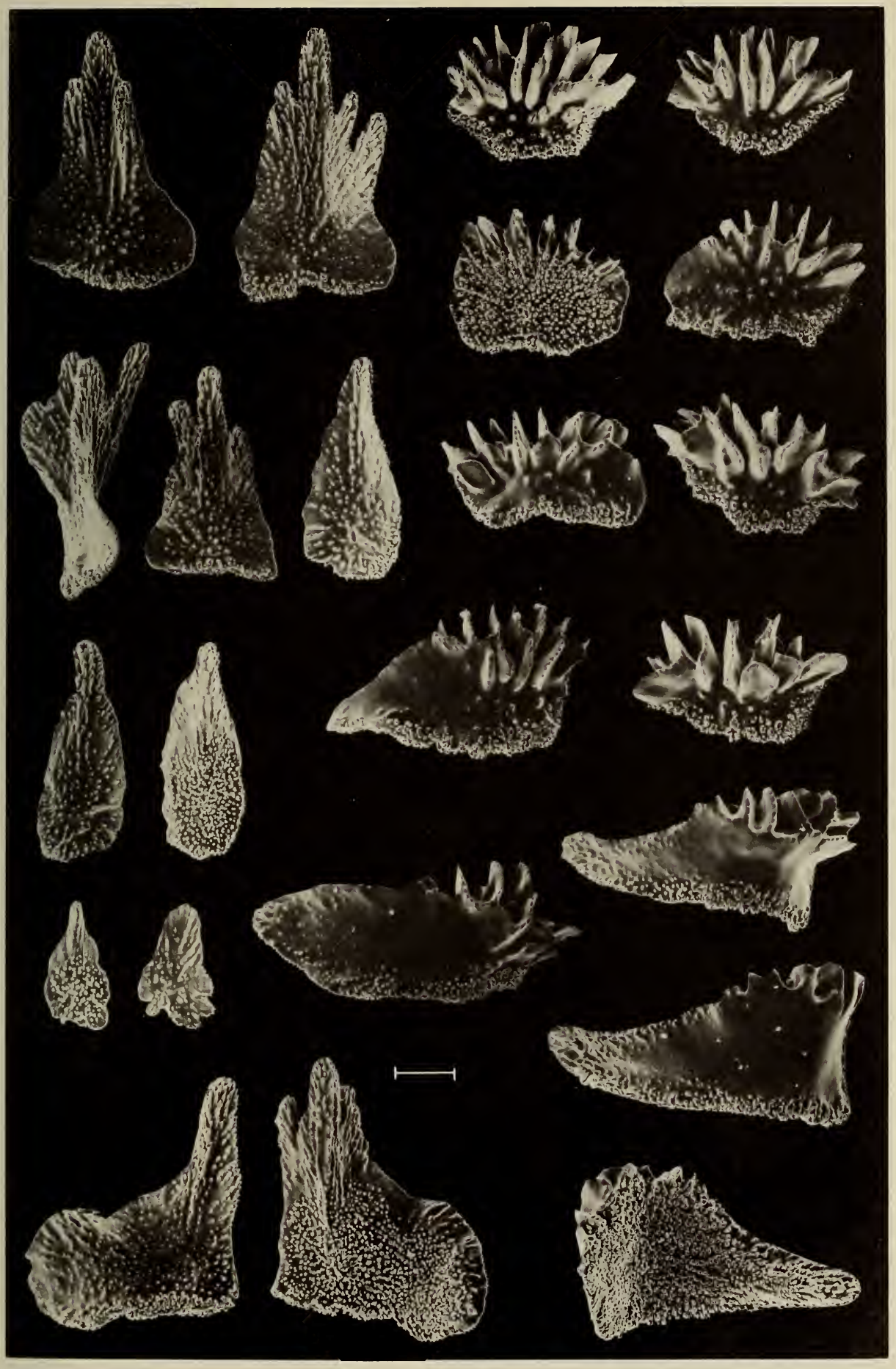


Fig. 5. *Callogorgia cristata* Aurivillius, USNM 57544: opercular, abaxial, outer-lateral, and modified opercular scales of polyp. Scale = 0.1 mm.

*Material examined.*—Japan, Goto Islands, off Pallas Rock, 32°15′N, 128°12′E, 160 m, coral bank, 15 May 1914, coll. S. Bock: small branch of type, USNM 44179 (Fig. 4, bottom).

Moluccas: off Ternate, 0°49′30″N, 127°25′30″E, 240 m, coral; *Albatross* sta. D5617, 27 November 1909: large branch and detached smaller branches, USNM 57544 (Fig. 4, top).—off Makian, 0°15′00°N, 127°24′35″E, 545 m, sand and coral; *Albatross* sta. D5621, 28 November 1909: one pinnate branch without base, USNM 60285.

*Description.*—See Aurivillius, 1931:262. Compare Versluys, 1906:73.

*Discussion.*—The specimens collected by the *Albatross* from Ternate and Makian, both off the west coast of Halmahera in the Moluccas, agree well with Aurivillius's account of *C. cristata,* and with Versluys's description of *C. weltneri.* The principal difference between *C. cristata* and *C. weltneri* cited by Aurivillius (1931:266) is the "somewhat greater number of polypal spicules, amounting to 8–9(–10) as against only 7" in *weltneri.* The present specimens tend to have somewhat more scales in the abaxial rows than was usual in *C. cristata,* but this character is subject to variation in all species of *Callogorgia.* Direct comparison by SEM of USNM 57544 (Fig. 4a) with type-material of *C. cristata* (Fig. 4b) reveals no other significant difference, so they can safely be considered conspecific. Even though Versluys (1906:74) reports no variation from 7 abaxials in *C. weltneri,* deviations almost certainly occur. A difference of 1 in the prevalent number of abaxial sclerites is a weak justification for specific separation so it is very likely that *cristata* and *weltneri* represent a single species. However, as type-material of *C. weltneri* has not been examined in this context, *C. cristata* is maintained. The inner basal angle of the inner-lateral opercular scales (IL-0) is in many cases expanded as a rounded lobe that extends into the position that would be occupied by the inner-lateral marginal scale (IL-1) if such a sclerite were developed (Fig. 5). This condition was not noticed by Aurivillius, but its inconsistent development may have led to its oversight.

### *Callogorgia chariessa,* new species
Figs. 6–8

*Material.*—One pinnately divided branch; Tawitawi Group, Sulu Archipelago, 5°18′10″N, 120°02′55″E (Tocanhi Point S.27°E, 2.1 miles), 49 fath. (90 m), coral sand and shell; *Albatross* sta. D5153, 19 February 1908. Holotype, USNM 58398.

*Description.*—*Callogorgia* with alternate pinnate branching in one plane, the nodes 5–10 mm apart and the undivided terminal branchlets about 2 cm long, producing the open type of pinnate branching that easily can be mistaken for dichotomous. Polyps in whorls of 3–5, commonly 4; in the terminal branchlets, 9 whorls commonly occur in 1 cm, uncommonly as many as 10 or 11. Diameter of undivided terminal branchlets 0.5 mm exclusive of polyps; axis alone about 0.3 mm in diameter, tapering to a hair-fine apex. Axis heavily calcified, longitudinally striated, creamy yellow with golden iridescence.

Polyps with only the two abaxial rows of scales well developed, 4 or 5 scales in each; one large outer lateral on each side, although this is occasionally absent, its place being occupied by the distalmost abaxial which then is sufficiently broad-

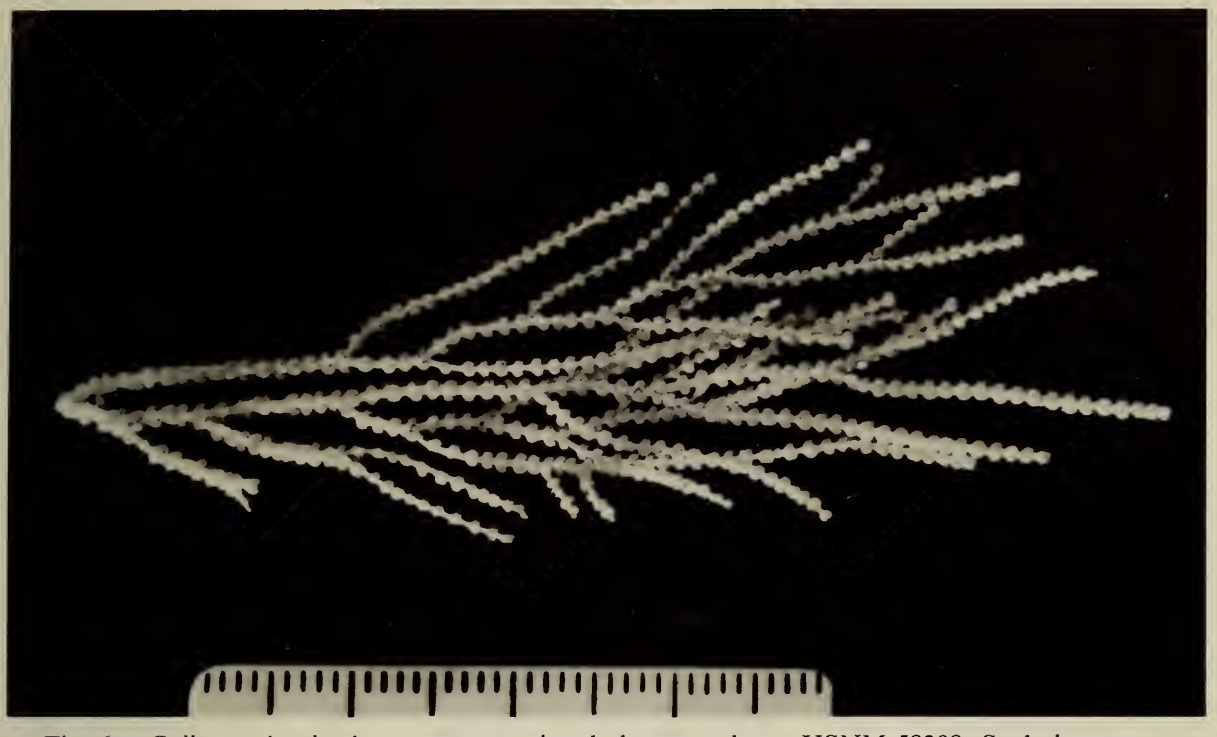


Fig. 6. *Callogorgia chariessa,* new species; holotype colony, USNM 58398. Scale in cm.

ened to cover the space; distal margins of the body scales strongly reflexed outward exposing the marginal radial ridges, which are high and crestlike. Opercular scales roughly triangular, with serrated edges, rounded basal angles and 1–4 serrated ridges on both outer and inner surfaces of the blunt apex; adaxial and inner lateral operculars conspicuously smaller than the abaxials and outer laterals. Exposed surface of scales with sparse granular sculpture, partly aligned in irregular radial rows, inner surface with compound tubercles. Cortical scales large, polygonal, closely interlocking by their marginal serrations.

*Comparisons.*—This species is similar to *C. minuta* and *C. similis* (Versluys, 1906:76, 78); the latter, in turn, is "im Habitus der *C. ventilabrum* äusserst ähnlich" (Versluys 1906:74, 76). *C. ventilabrum,* which originally was collected in 162 m north of New Zealand by the *Gazelle* Expedition, has 7 scales in the abaxial rows (as determined by Versluys 1906:75, who examined a part of the type colony) compared with 5 or fewer in *C. chariessa.* The inner distal edges of the body scales of *C. ventilabrum* have sharp radial ridges but they are comparatively low and not conspicuously exposed by the outward reflexion of scale margins as in *C. chariessa.*

*Callogorgia chariessa* resembles *C. minuta* even more closely, but the whorls tend to be more closely placed (as many as 10 or 11 per cm, though commonly 9) than in that species (8 or 9 per cm), and to consist of a larger number of polyps (commonly 4, sometimes 3 or 5, compared with 2 or occasionally 3 but rarely 4 in *minuta*). The margins of the body scales are strongly reflexed in *C. chariessa,* conspicuously exposing the marginal ridges to view. In this regard, *C. affinis* approaches *C. chariessa* more closely, but the polyps have 7 scales in the abaxial rows as opposed to 5 (or even 4) in *C. chariessa,* and the margins of the body scales are not so conspicuously reflexed.

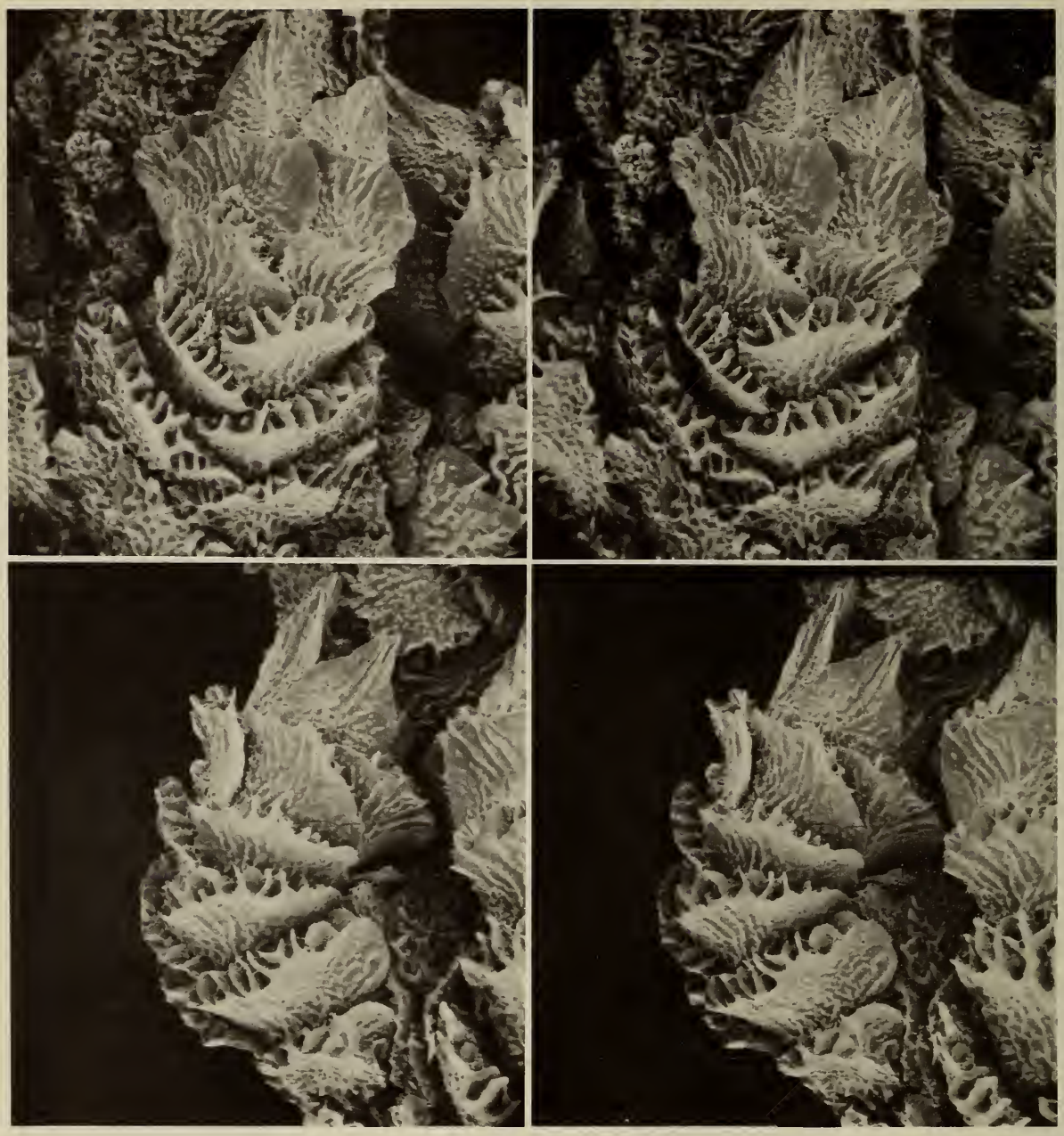


Fig. 7. *Callogorgia chariessa,* new species; holotype, USNM 58398: abaxial and right lateral views of polyp. SEM stereo pairs, ×67.

When more material becomes available for an assessment of variation, it may prove that all of these basically similar forms belong to a single variable species, but for the present time it is preferable to call attention to the differences between them.

*Callogorgia formosa* Kükenthal
Figs. 9–10

*Caligorgia formosa* Kükenthal, 1907:208 (Südwestlich von Gross-Nikobar, 362 m); 1919:366, figs. 155–159, pl. 30, fig. 1, pl. 40, fig. 47; 1924:269, fig. 153.
*Primnoella indica* Kükenthal, 1907:210.

*Material examined.*—Hawaiian Islands: north Bank of Necker Island, 250 fath.

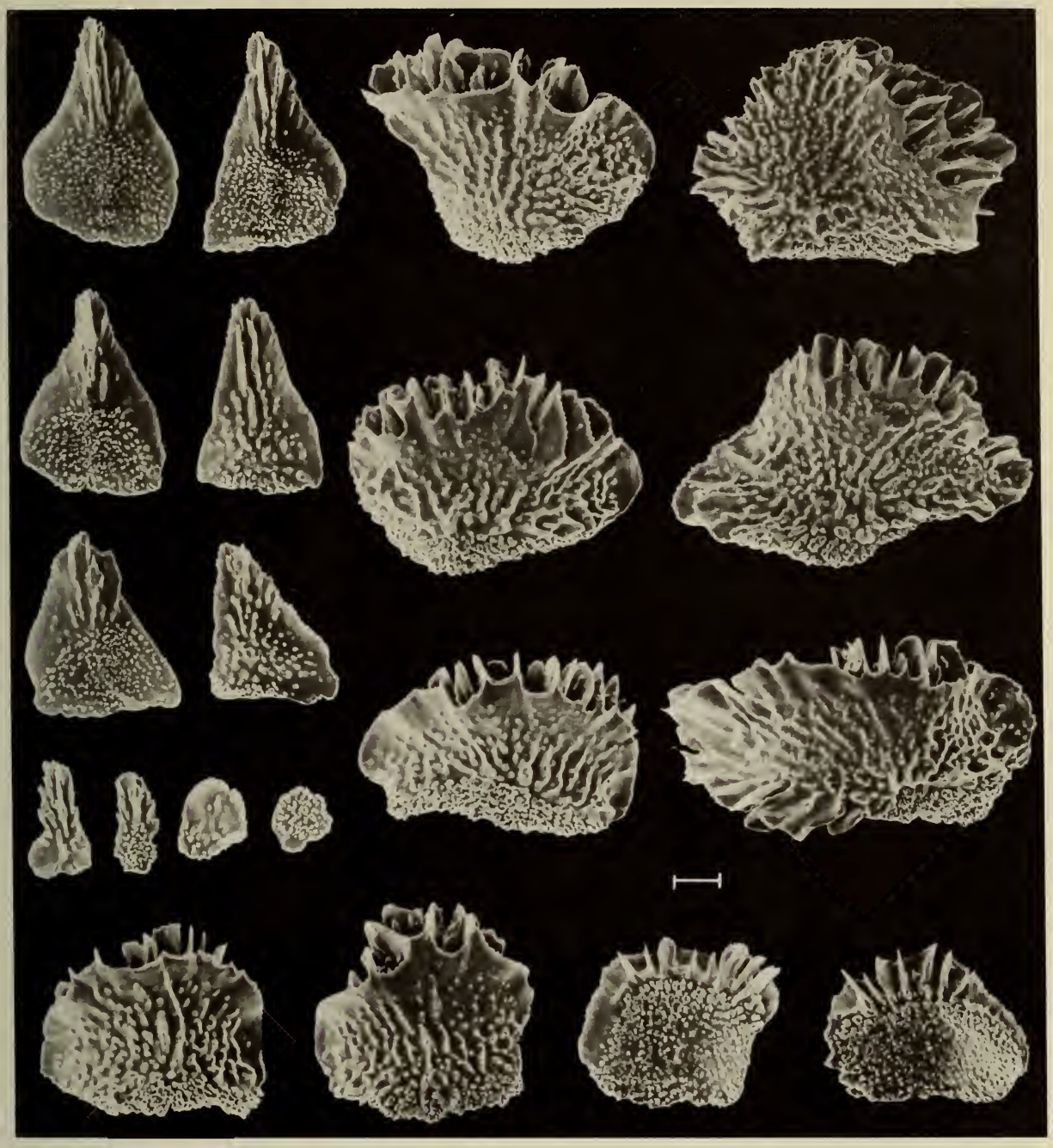


Fig. 8. *Callogorgia chariessa*, new species; holotype, USNM 58398: opercular, adaxial marginal, abaxial and outer-lateral sclerites of polyp. Scale = 0.05 mm.

(458 m), *Townsend Cromwell* 76-06-73, sta. 4, 15 October 1976; large colony broken into 4 pieces: USNM 60692.—Off Necker Island, 23°39′N, 164°31′W, 80–162 fath. (146–296 m), *Townsend Cromwell* sta. 6, 16 October 1976; two badly damaged pinnate fragments: USNM 60291.

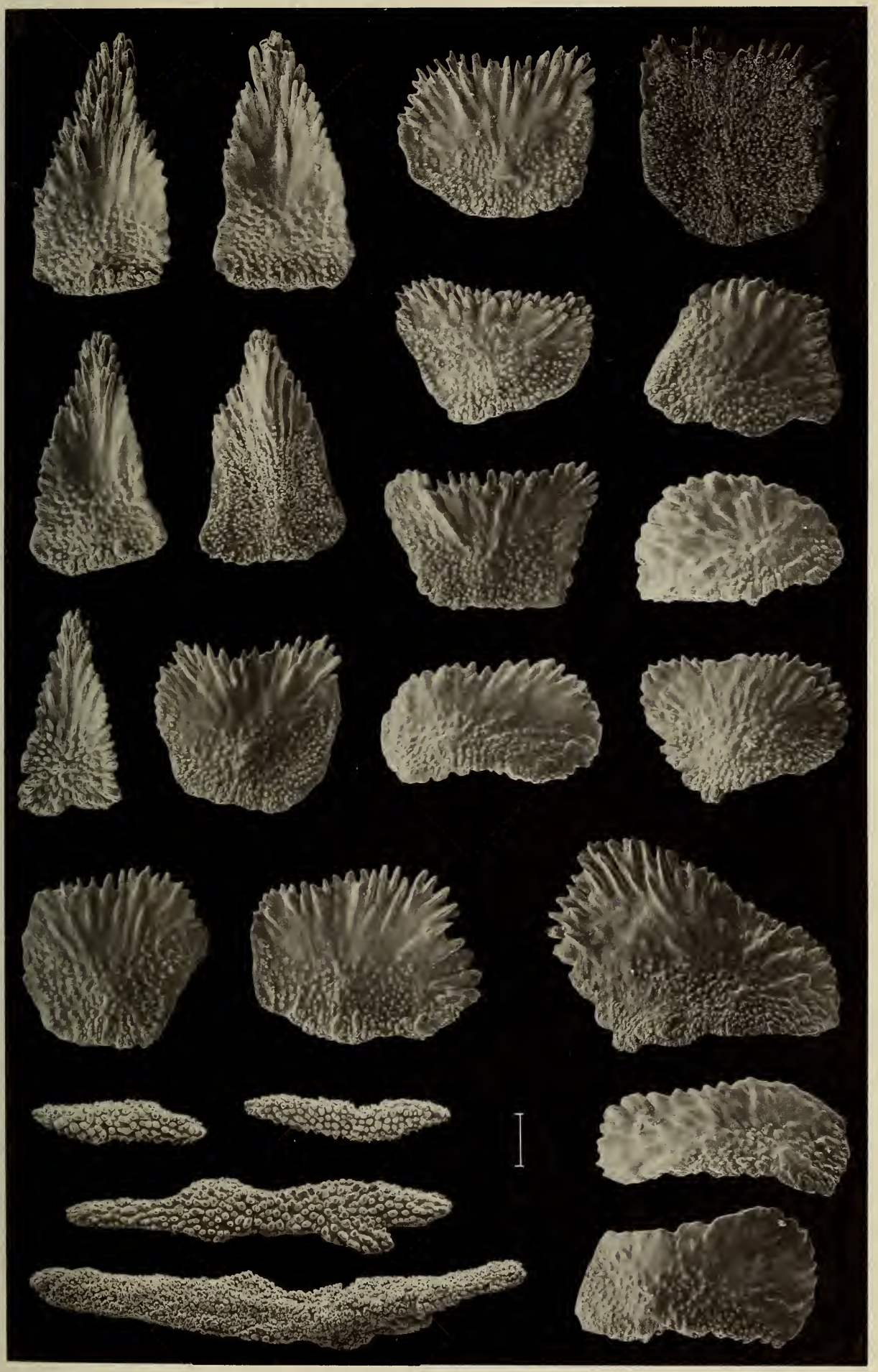
*Description.*—A large, plumose colony, broken in 4 pieces measuring 29.5, 18.5, 12.2 and 8.3 cm, corresponds in all essentials with the description and figures of *C. formosa* given by Kükenthal (1919). Evidently broken off well above the holdfast, the intact colony must have approached 1 m in height. It is a rather stiff and brittle pinnate plume with strictly opposite, undivided branches up to 14.5 cm long, the distal ones rather quickly decreasing in length toward the apex.

Fig. 9. *Callogorgia formosa* Kükenthal, USNM 60692: left lateral and abaxial views of polyp. SEM stereo pairs, ×38.

The polyps occur on the branches in rather well-separated whorls of 3 or 4 distally, increasing proximad to 5, usually 4 in 1 cm; they are in whorls also on the main axis near its apex, but this arrangement is soon lost and only widely scattered individuals persist on the lower parts of the trunk. The size, shape, and

→

Fig. 10. *Callogorgia formosa* Kükenthal, USNM 60692: sclerites of coenenchyme, three outer, one inner view; opercular, adaxial marginal, abaxial and outer-lateral sclerites of polyp. Scale = 0.1 mm.



armature of the polyps is essentially as described by Kükenthal (1919). He makes the point (1919:367) that only the distalmost abaxial scales are wider than high, the rest being rounded or trapezoidal in outline. However, judging by his drawing (op. cit.: fig. 155), it appears that the proximal abaxial scales may have suffered some breakage, as is the case in the present specimens. When intact, the proximal abaxial scales are broad and tapering, extending well around the sides of the polyp. The outer-lateral rows are unusually well developed for the genus, composed of 6 or more scales. Except for the distal scales, it is difficult to confirm Kükenthal's counts for the inner-lateral and adaxial rows, as the proximal scales imperceptibly merge with the coenenchymal sclerites, which in full development are long, irregular spindles sometimes with blunt lobes. The body scales have only fine granulation externally, but no trace of radial ridges or crests; internally, they are covered with crowded complex tubercles of usual form, and the distal margins are sharply and conspicuously toothed. The tentacles are devoid of sclerites.

*Relationships.*—Kükenthal (1919:369) considered this species so unusual that it might merit a new genus distinct from *Callogorgia*. Although he considered that in form of the polyps *C. formosa* conformed with other species of *Callogorgia*, he had actually mistaken detached branches for a new species of *Primnoella* (Kükenthal, 1907:210, 1919:368). This demonstrates the difficulty of even generic identification because of the ambiguity of many taxonomic characters in the Octocorallia.

*Distribution.*—In view of its type-locality in the Indian Ocean off Great Nicobar Island, the discovery of *C. formosa* in Hawaiian waters is of no little interest. Its distribution therefore parallels that of *Fanellia tuberculata*, first found off the Sulu Islands and now reported from Hawaii, but it has not been reported even as a synonym from intermediate localities as has *F. tuberculata*. It is probable that this large distributional gap results only from inadequate sampling. The other species of *Callogorgia* known from Hawaii, *C. gilberti* Nutting, is more closely related to *C. kinoshitae* Kükenthal from California and *C. verticillata* (Pallas) *sensu* Deichmann from the Caribbean than to any species from the Indo-west Pacific.

## *Fanellia* J. E. Gray, 1870

*Fanellia* J. E. Gray, 1870:46 (type-species, *Primnoa compressa* Verrill, 1865; by monotypy).

*Caligorgia.*—Auct. (in part).

*Diagnosis.*—Primnoid colonies branched in dichotomous or lax pinnate manner simulating dichotomous, rarely close pinnate, usually but not always in one plane. Polyps upturned, verticillate, in whorls of 2–12; sclerites of polyps arranged in longitudinal rows in which the distalmost circle of 8 triangular or lanceolate scales (operculars) is always present; the two abaxial rows of body scales always fully developed but the outer-lateral, inner-lateral and adaxial rows are more or less reduced in number of scales owing to inward curvature of the polyps in contraction (i.e., the adaxial body wall is more or less naked); tentacles devoid of sclerites. Coenenchymal sclerites in the form of thick, closely fitting, rounded or

polygonal plates presenting a cobblestone-like aspect. Sclerites sculptured externally by closely set, angular tubercles that may fuse to form serrated ridges irregularly meandering or more or less distinctly radiating outward from the center, internally by very complex, crowded tubercles not regularly aligned.

*Comparisons.*—This genus closely resembles *Callogorgia* but is distinguished by the external sculpturing of the sclerites, which does not intergrade with the type of ornamentation developed in *Callogorgia*. The growth form is predominantly dichotomous, or so openly pinnate that it appears to be dichotomous (here called 'quasi-dichotomous'), but only rarely is it closely pinnate (*F. granulosa*). In most *Callogorgia* species it is regularly pinnate, in some becoming more lax, but in a few species described (e.g., *C. antarctica*) it is dichotomous as in *Fanellia compressa*. However, several of these dichotomous species seem to be referable to the genus *Ascolepis* Thomson and Rennet on the basis of sclerite form. If not, the branching of *Fanellia* and *Callogorgia* will be equivalent, in that both pinnate and dichotomous conditions occur, together with the quasi-dichotomous intermediate. In *Fanellia,* branching is predominantly dichotomous, in *Callogorgia* predominantly pinnate. In *Ascolepis,* branching varies even more, ranging from unbranched (*nodosa*) to typical dichotomous (*splendens, antarctica*), lax pinnate or quasi-dichotomous (*spinosa*) and bottle-brush form (*abies*).

*Geographical distribution.*—*Fanellia* appears to be confined to the Pacific Ocean, occurring from the Gulf of Alaska and Aleutian Islands to Japan, Indonesia, Marshall Islands, Hawaii, and as far south as New Caledonia. No species recognizable as belonging to *Fanellia* has been reported from the Indian Ocean or from the Southern Ocean. In contrast, *Callogorgia* occurs in all seas (unless all of those from the Southern Ocean prove to be species of *Ascolepis*), and *Ascolepis* occurs only in Antarctic and Subantarctic waters.

## Key to Species of *Fanellia*

1(4). Terminal branches long (15–30 cm), branching dichotomous or quasi-dichotomous; polyps in whorls of 8–12.

2(3). Polyps with 7–8 scales in each abaxial row, 2 in outer-lateral rows ... ..... *F. fraseri* (Hickson)

3(2). Polyps with 10–11 scales in each abaxial row, 5–7 in outer-lateral rows ..... *F. compressa* (Verrill)

4(1). Terminal branches shorter (7 cm or less), branching clearly pinnate or quasi-dichotomous; polyps in whorls of 2–5.

5(6). Branching distinctly pinnate ..... *F. granulosa* (Kinoshita)

6(5). Branching quasi-dichotomous.

7(8). Colonies flabellate, compressed or in one plane; polyps with 5–8 scales in abaxial rows, 1 or 2 outer laterals, 1 inner lateral ..... ..... *F. tuberculata* (Versluys)

8(7). Colonies corymbose, not in one plane; polyps with 5 (occasionally 6) scales in abaxial rows, one wide marginal scale occupying the combined inner and outer lateral positions on both sides; no separate inner lateral ..... *F. corymbosa,* n. sp.

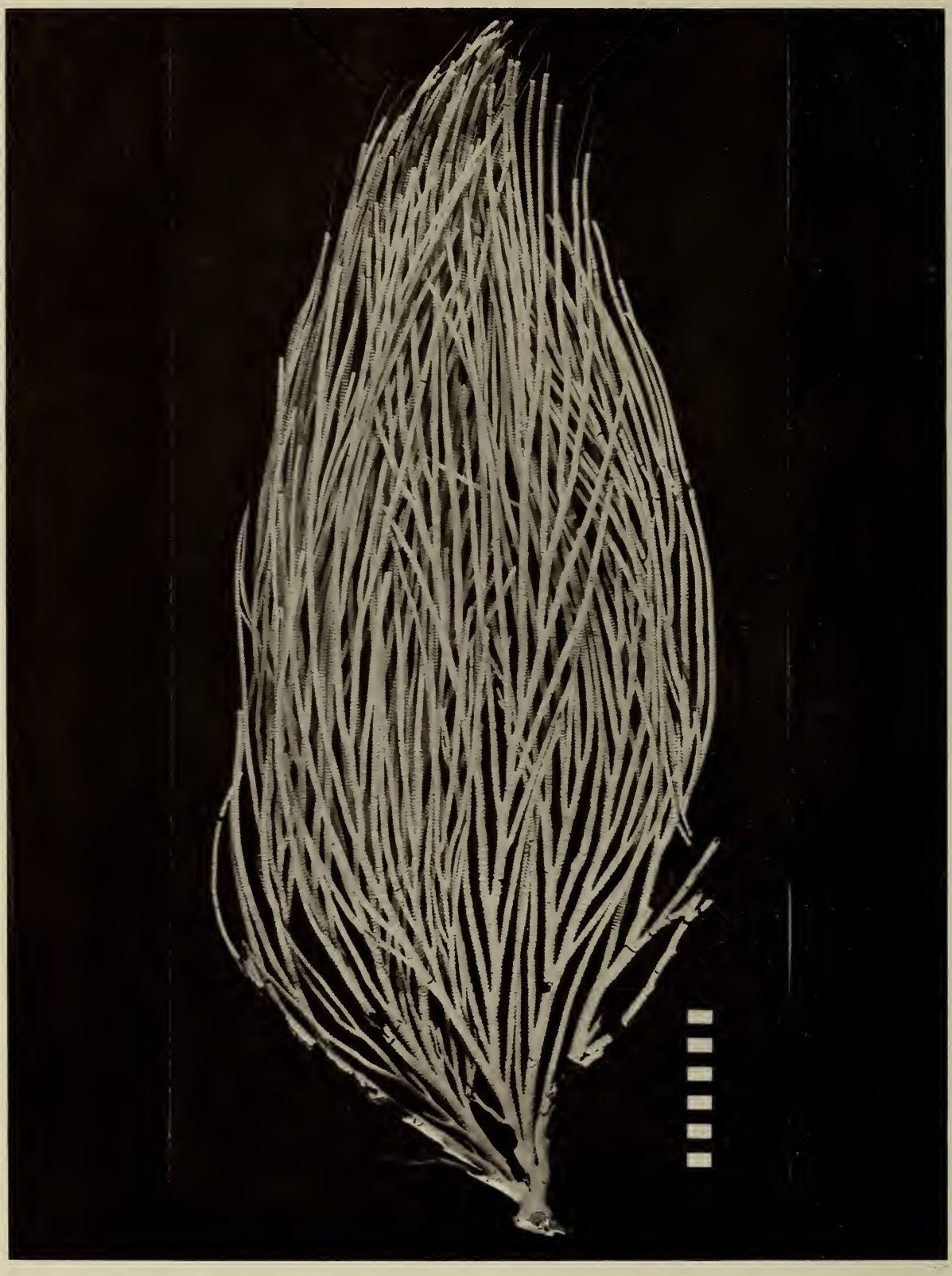


Fig. 11. *Fanellia compressa* (Verrill), USNM 60281: complete colony. Divisions of scale are cm.

*Fanellia compressa* (Verrill, 1865)
Figs. 11–14

*Prymnoa verticillaris*.—Ehrenberg, 1834:357.
non *Gorgonia verticillata* Pallas, 1766:177.

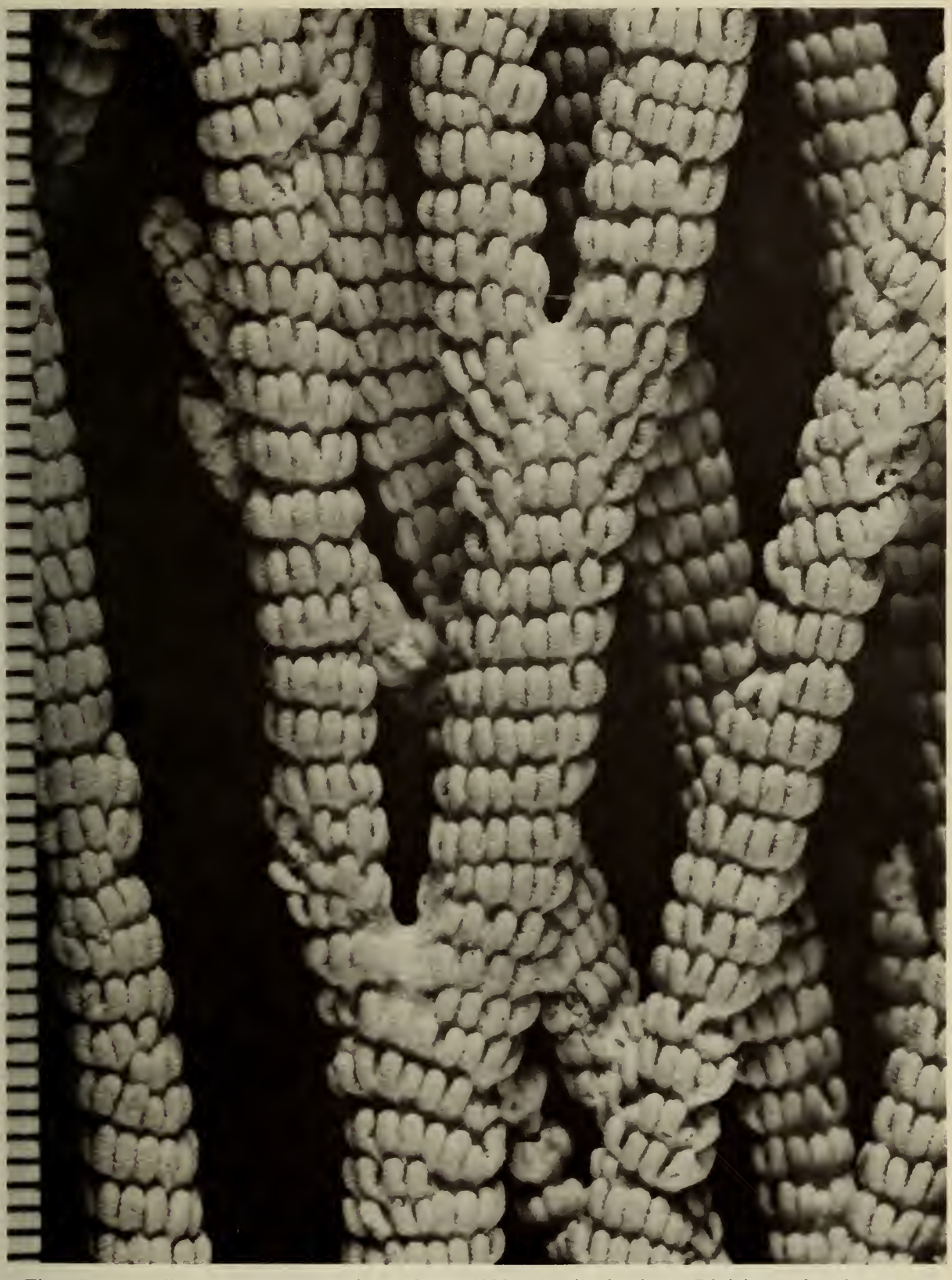


Fig. 12. *Fanellia compressa* (Verrill), USNM 60281: detail of colony. Divisions of scale are mm.

non *Gorgonia verticillaris* Linnaeus, 1767:1289.—Ellis and Solander, 1786:83.—Statius Müller, 1775:753.—Houttuyn, 1772:309, pl. 132, fig. 1.
non *Callogorgia verticillata*.—Gray, 1858:286.
*Primnoa compressa* Verrill, 1865:189 (Aleutian Islands).

Fig. 13. *Fanellia compressa* (Verrill), USNM 57543: top, whorl of polyps, ×27; bottom, oblique view of polyp, ×44. SEM stereo pairs.

*Fanellia compressa*.—Gray, 1870:46 (new genus for *Primnoa compressa* Verrill). *Caligorgia compressa*.—Versluys, 1906:81.—Kükenthal, 1924:276.

*Material examined*.—Amchitka, Aleutian Islands, 51°32′N, 179°15′W, 278–289 m, K. K. Chew, coll. 2 September 1968: 4 colonies, complete or nearly so, USNM 60281 (Figs. 11, 12, 14).

Bering Sea, 52°05′N, 177°40′E, 100 m, *Albatross* sta. 3599, 9 June 1894: 1 colony, USNM 57542.

Bering Sea, 52°14′N, 174°13′E, 882 m, *Albatross* sta. 4781, 7 June 1906: 1 colony, somewhat broken, USNM 57543 (Fig. 13).

*Description*.—Colonies flabellate, branched in a very loose pinnate manner that simulates dichotomous (i.e., quasi-dichotomous), lateral branches arising alter-

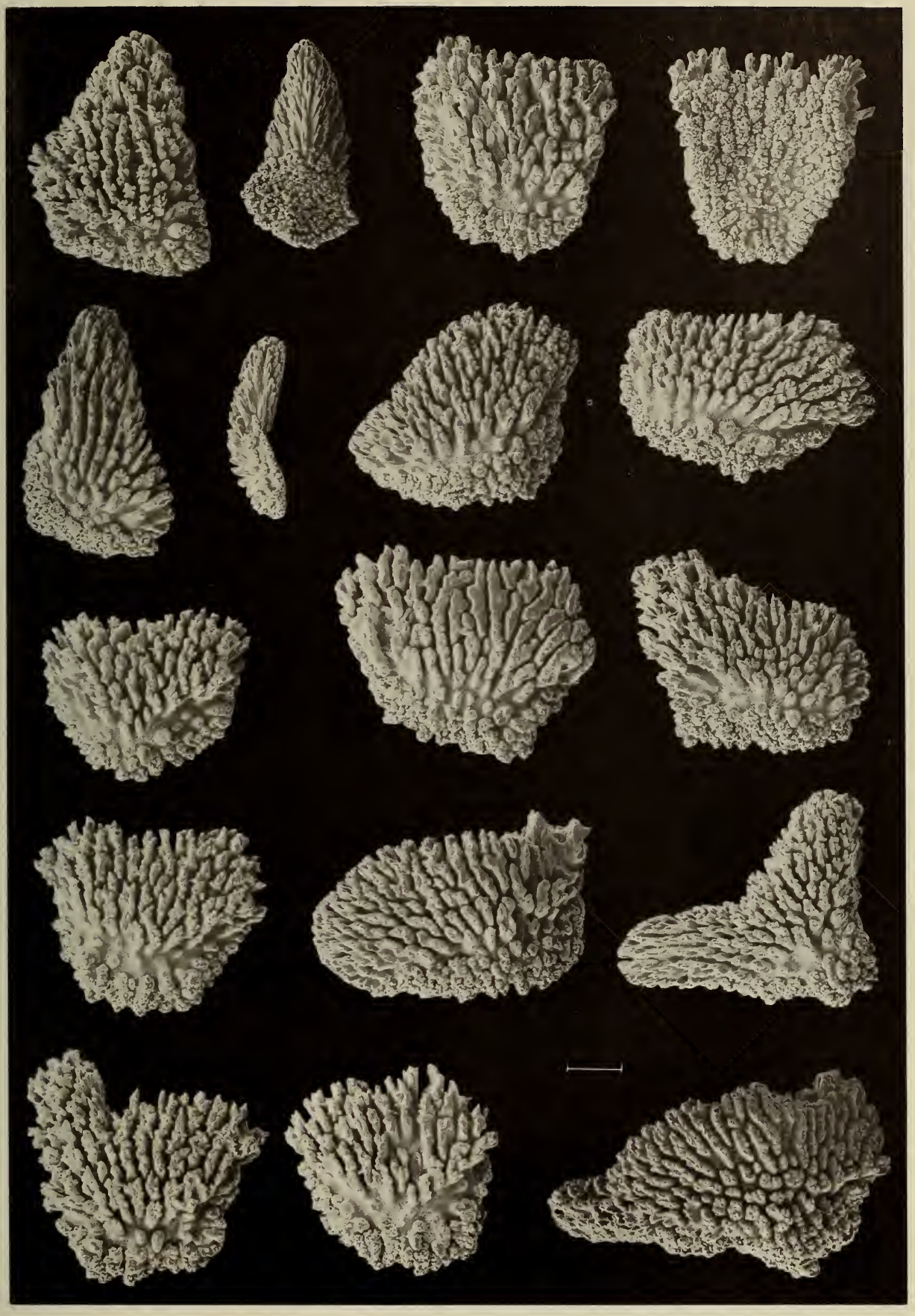


Fig. 14. *Fanellia compressa* (Verrill), USNM 60281: opercular, abaxial, outer-lateral sclerites of polyp. Scale = 0.1 mm.

nately, mostly 30–40 mm apart, the undivided terminal branches up to 30 cm long, nearly straight. The polyps are situated around the branches in closely placed whorls of 8–12 distally, increasing in numbers proximad until in the major branches there may be 14–16; on the larger branches some of the whorls may be oblique, some incomplete, resulting in a spiral appearance; 4–6 whorls occur in 1 cm of length. The polyps are about 1.5 mm tall in the contracted state; the two abaxial rows of sclerites consist of 10–11 scales each, the outer laterals 5–7, the inner laterals 2–3, and the adaxials 1. Because of the greater number of inner and outer lateral scales in *F. compressa* as compared with *F. fraseri,* the winglike lateral expansion of the abaxial scales has room for development only on those in the more proximal positions, so it occurs only from Abax-7 to 10; the outer laterals, beginning between OL-4 and 6, depending upon the number of inner laterals present, also develop lateral expansions, as may one or more of the inner laterals. All of the body scales are sculptured externally by closely placed, minutely aculeate ridges irregularly radiating outward from the nucleus. Where exposed, the coenenchymal sclerites are large, closely fitting polygonal plates similarly sculptured, but where covered by the contracted polyps they are smaller tuberculate spheroids. Small, warty spheroids also occur sparsely in the mesogloea between the longitudinal stem canals and immediately surrounding the axis (i.e., the axial sheath).

*Comparisons.*—This species resembles *F. fraseri* but seems to grow larger. The polyps are larger, the lateral scale rows better developed, and the sculpturing more complex.

*Remarks.*—Although Verrill's original specimens lacked coenenchyme, the locality from which they came makes it probable that they were the species here described. *Prymnoa verticillaris* Ehrenberg could have been either this species or *F. fraseri,* as Studer (1878:647) pointed out that Ehrenberg's material was obtained in the North Pacific by the Rurik Expedition. Ehrenberg's statement that the polyps had 8 scales in the abaxial rows ("scutellorum serie dorsuali longitudinali duplici, trasversis 8") makes it slightly more likely that he had *fraseri* in hand, although the difficulty of counting scales accurately leaves room for doubt. The matter is of no nomenclatural significance because Ehrenberg used the variant spelling employed by Linnaeus for *Gorgonia verticillata* Pallas.

### *Fanellia fraseri* (Hickson, 1915)
Figs. 15–17

*Caligorgia fraseri* Hickson, 1915:553, fig. 4, pl. 1, fig. 2 (Albatross and Portlock banks, Gulf of Alaska, 50–100 fath. on halibut lines); 1917:23.—Kükenthal, 1924:279.

*Material examined.*—Gulf of Alaska: Albatross and Portlock banks, 50–100 fathoms (92–183 m); two loosely pinnate branches, paratypes, British Museum (Nat. Hist.) 1962.7.20.821 (figured by Hickson) and 1962.7.20.822 (Fig. 15B).—Albatross Bank, 100–125 fath. (183–229 m); M/S *Dorothy,* Alaska King Crab Investigations, sta. C-45, 28 March 1941; three branches, probably from a single colony, USNM 51284 (Fig. 15A).

*Description.*—Like Hickson's original specimens, the present topotypic material consists of branches possibly from a single colony. Two of the branches

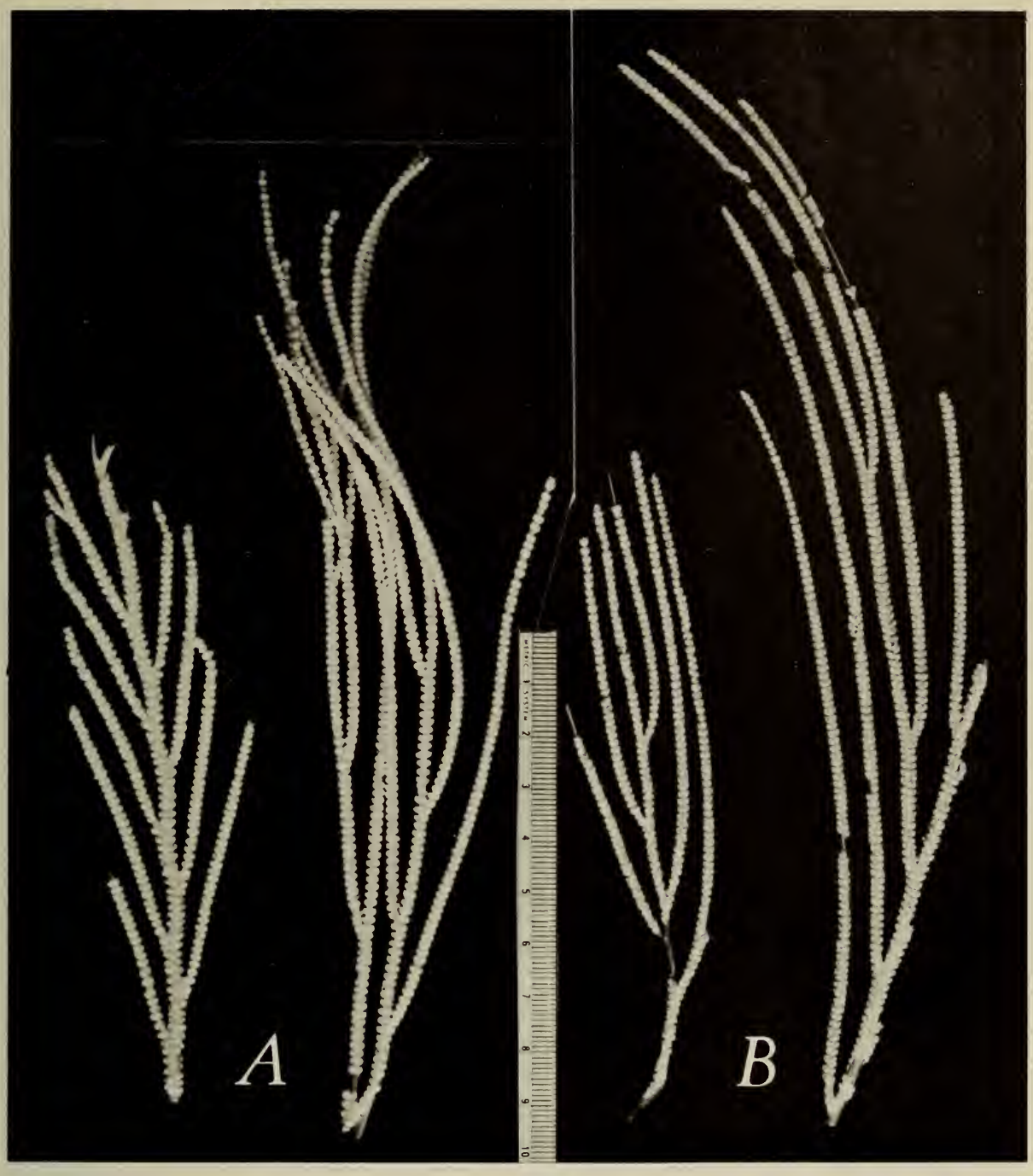



Fig. 15. *Fanellia fraseri* (Hickson): *A*, USNM 51284; *B*, paratypes, BM(NH) 1962.7.20.821 (figured by Hickson) and 1962.7.20.822. Scale in cm.

(one illustrated in Fig. 15A, right) are very loosely pinnate just as Hickson (1915:553) described the types, but the third (Fig. 15A, left) is more distinctly pinnate and probably came from a position lower in the colony. The longest undivided terminal branchlet is 15 cm long. Distally the polyps are set in whorls of 5–8, increasing to 12 in the lowest parts of the colony preserved; 6–7 whorls occur in 1 cm of length. The polyps are about 1 mm tall in the contracted state; the two abaxial rows of sclerites consist of 7–8 scales each (although the distinction between the lowest abaxial scale and the adjoining coenenchymal sclerites is often so unclear that an accurate count is difficult to make), and the 3rd, 4th

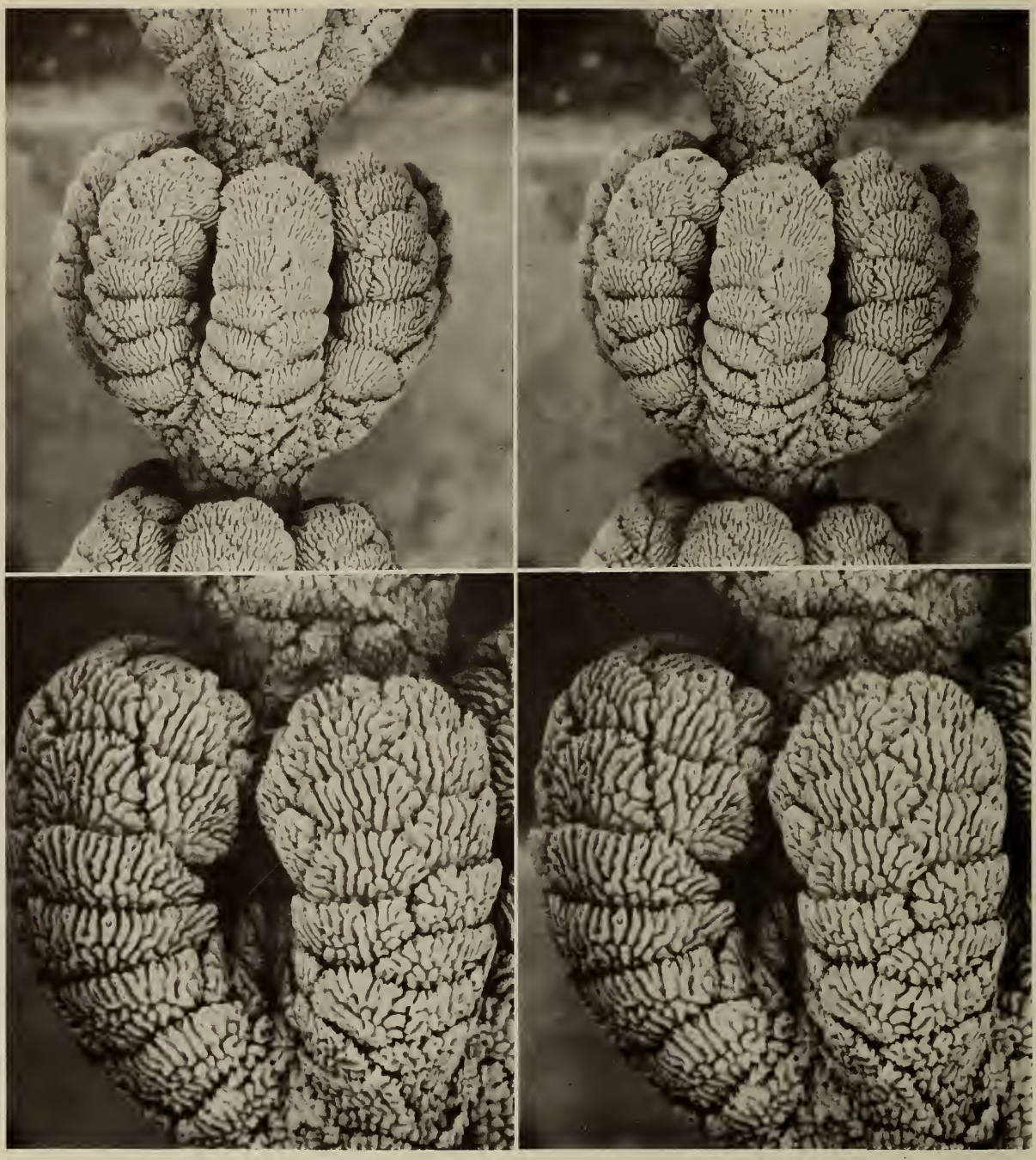


Fig. 16. *Fanellia fraseri* (Hickson), USNM 51284: top, whorl of polyps, ×25; bottom, oblique view of polyp, ×42. SEM stereo pairs.

and 5th on each side have inconspicuous to moderate "winglike expansions" (as observed by Versluys, 1906:81, Fig. 95, for *C. tuberculata*); the outer-lateral rows usually have 2 scales each, the inner laterals 1, and the adaxials 1 small scale (sometimes missing) below each opercular; the larger coenenchymal sclerites are closely fitting polygonal plates externally covered by irregular, close-set ridges; where covered by the contracted polyps, they are smaller, tuberculated grains of irregular shape.

*Comparisons.*—This species is generally similar to *F. compressa,* with the following differences: branching tends to be somewhat closer and therefore more distinctly pinnate; polyps smaller, fewer scales in the abaxial and outer-lateral

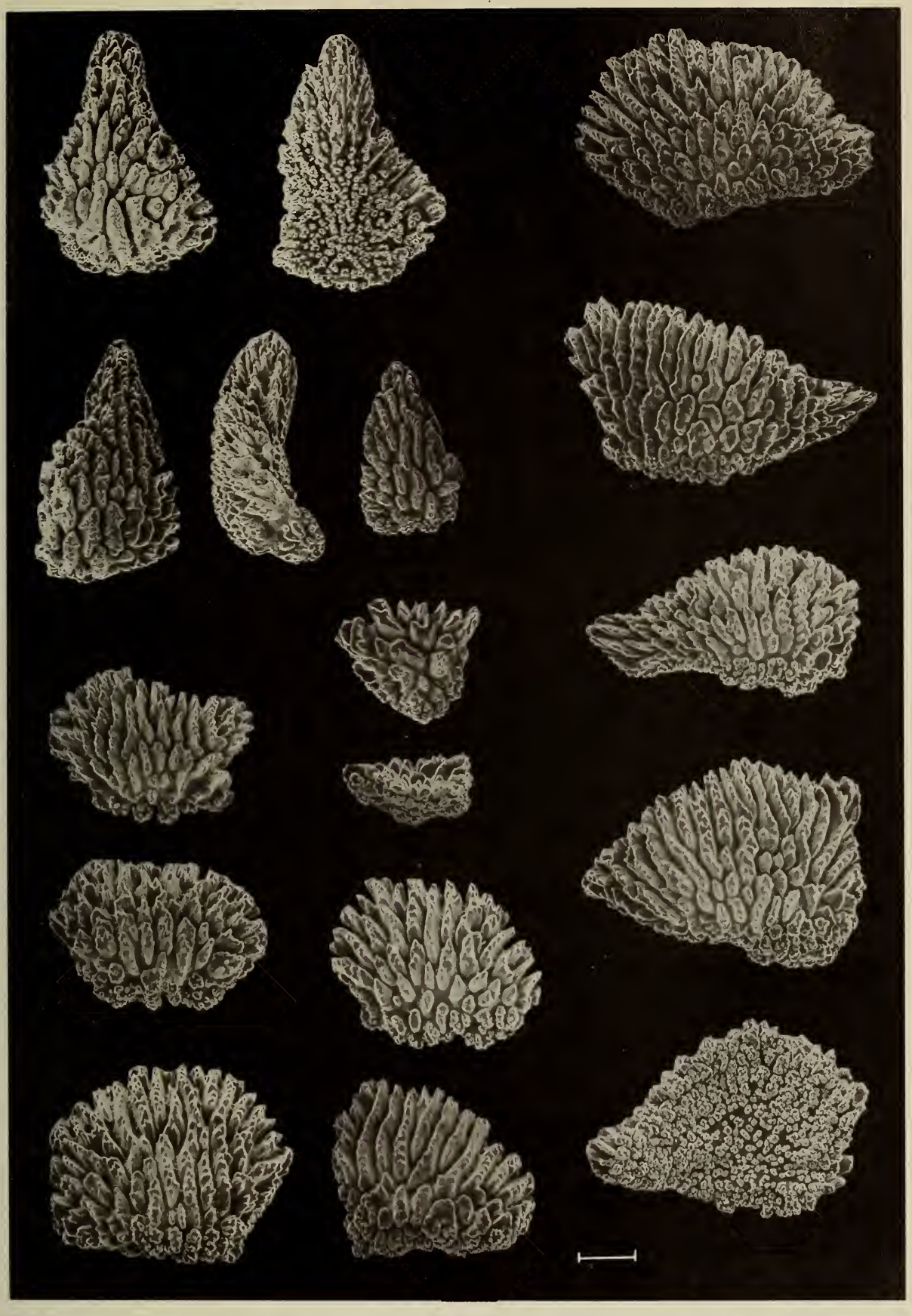


Fig. 17. *Fanellia fraseri* (Hickson), USNM 51284: opercular, adaxial marginal, abaxial, outer-lateral and inner-lateral sclerites of polyp. Scale = 0.1 mm.

rows; winglike lateral expansions of the body scales weakly or moderately developed on Abax-3, 4 and 5, and not at all on outer laterals or inner laterals.

*Remarks.*—The type-lot was obtained by Prof. Arthur Willey from halibut lines on Albatross and Portlock banks in the Gulf of Alaska, where it was reported as common. The color in life was described as pink.

### *Fanellia granulosa* (Kinoshita, 1907)

*Caligorgia granulosa* Kinoshita, 1907:231 ("Sagami- und Kagoshima-See"); 1908a:37, pl. 2, figs. 13–14, pl. 6, fig. 46 ("Westküste von Satsuma"); 1908b: pl. 18, fig. 2; 1909:2.

*Caligorgia tuberculata.*—Kükenthal, 1924:278 (part).

*Material examined.*—None.

*Discussion.*—Kinoshita (1908a:40) stated that the sculpture of the sclerites of *C. aspera* and *C. granulosa* is the same, but that the species differ in branching and arrangement of polyps. Although his very clear photographs (Pl. 2, figs. 13, 14) of *C. granulosa* show a distinctly pinnate colony, they also show that the distal parts of branches, if isolated, could easily be interpreted as dichotomous. Moreover, the differences between the polyps of the two are negligible; even the presence of 1–3 adaxial body scales below the operculum in *aspera* compared with "vereinzelten Schuppen" in *granulosa* is of no significance. In view of the intraspecific variation in colonial form that can occur under different ecological conditions, it seems likely that *C. granulosa, C. aspera* and *C. tuberculata* are indeed but a single species as interpreted by Kükenthal. Although there is little doubt that *Caligorgia aspera* Kinoshita is a junior synonym of *Fanellia tuberculata* (Versluys), I prefer for the moment to retain Kinoshita's *C. granulosa* as a distinct species, now referred to the genus *Fanellia,* because no authentic material has been available for examination.

*Diagnosis.*—Colonies pinnately branched.

### *Fanellia tuberculata* (Versluys)
Figs. 18–26

*Caligorgia tuberculata* Versluys, 1906:80, figs. 95, 96, pl. 6, fig. 15 (Sulu-Inslen, 5°43.5′N, 119°40′E, 522 m).—Kükenthal, 1924:278 (part).

*Caligorgia aspera* Kinoshita, 1908a:39, pl. 2, figs. 15, 16; pl. 6, fig. 47 (Westküste von Satsuma).—Nutting, 1912:61.

*Caligorgia flabellum.*—Nutting, 1912:60.

*Caligorgia pseudoflabellum* Bayer, 1949:207, fig. 2a–c, pl. 4, fig. 2 (Bikini Atoll, off Enyu Pass, 11°29′28″N, 165°31′40″E, 116–120 fath.).

*Material examined.*—Hawaiian Islands: Middle Bank, 22°47.5′N, 161°02.2′W, to 22°47.9′N, 161°02.3′W, 382 m, *Townsend Cromwell* TC78, 11 January 1978; broken branches, possibly from one large colony, USNM 56791 (Fig. 19).—Kaena Point, Oahu, 21°35.85′N, 158°24.55′W, 275–445 m, "Sango XII" haul 1, 27 July 1971; broken branches and part of main trunk of a large colony, USNM 60348.—Makapuu, Oahu, 21°18.0′N, 157°32.7′W, 362 m, "Sango XIV" haul 1, 18 January 1972; 1 small colony lacking holdfast, USNM 60290 (Figs. 18, 20).

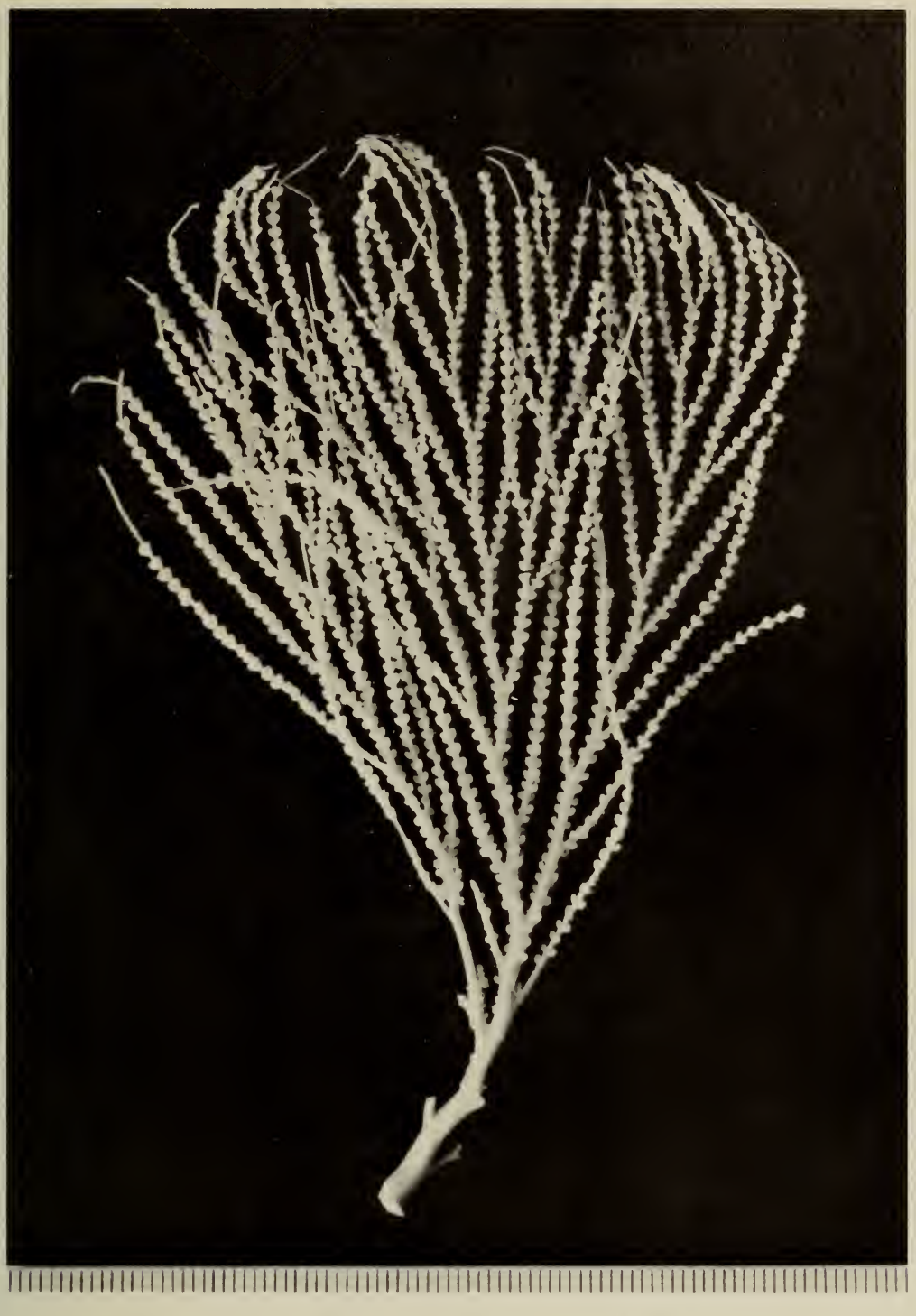


Fig. 18. *Fanellia tuberculata* (Versluys) from Hawaii, USNM 60290: typical quasi-dichotomous colony with sterile twig tips. Scale divisions are mm.

Marshall Islands: Bikini Atoll, off Enyu Pass, 11°29′28″N, 165°31′40″E, 212–220 m, dredge sta. 30, 22 August 1947; one branch, broken in two pieces, from a larger colony, holotype of *Caligorgia pseudoflabellum* Bayer, USNM 44089 (Figs. 21, 22).

Japan: Honshu, Ose Zaki S.36°, W 0.8 mi, 65–125 fath., volcanic sand, shells, rock, *Albatross* sta. 3716, 11 May 1900; large dichotomously divided branch

Fig. 19. *Fanellia tuberculata* (Versluys) from Hawaii, USNM 56791: right and left lateral views of polyp. SEM stereo pairs, ×56.

lacking holdfast, USNM 49582 (Fig. 23); smaller branch, part of preceding?, USNM 57523.—Kyushu, off Kagoshima Wan, 30°54′40″N, 130°37′30″E, 103 fath., stones, *Albatross* sta. 4936, 16 August 1906; flabellate colony with holdfast, with broken branches, *Caligorgia flabellum* det. Nutting, USNM 30029 (Figs. 24, 26); branch without holdfast, part of preceding?, *Caligorgia aspera* det. Nutting, USNM 30075.—Kyushu, Westküste von Satsuma; small branch of colony det.

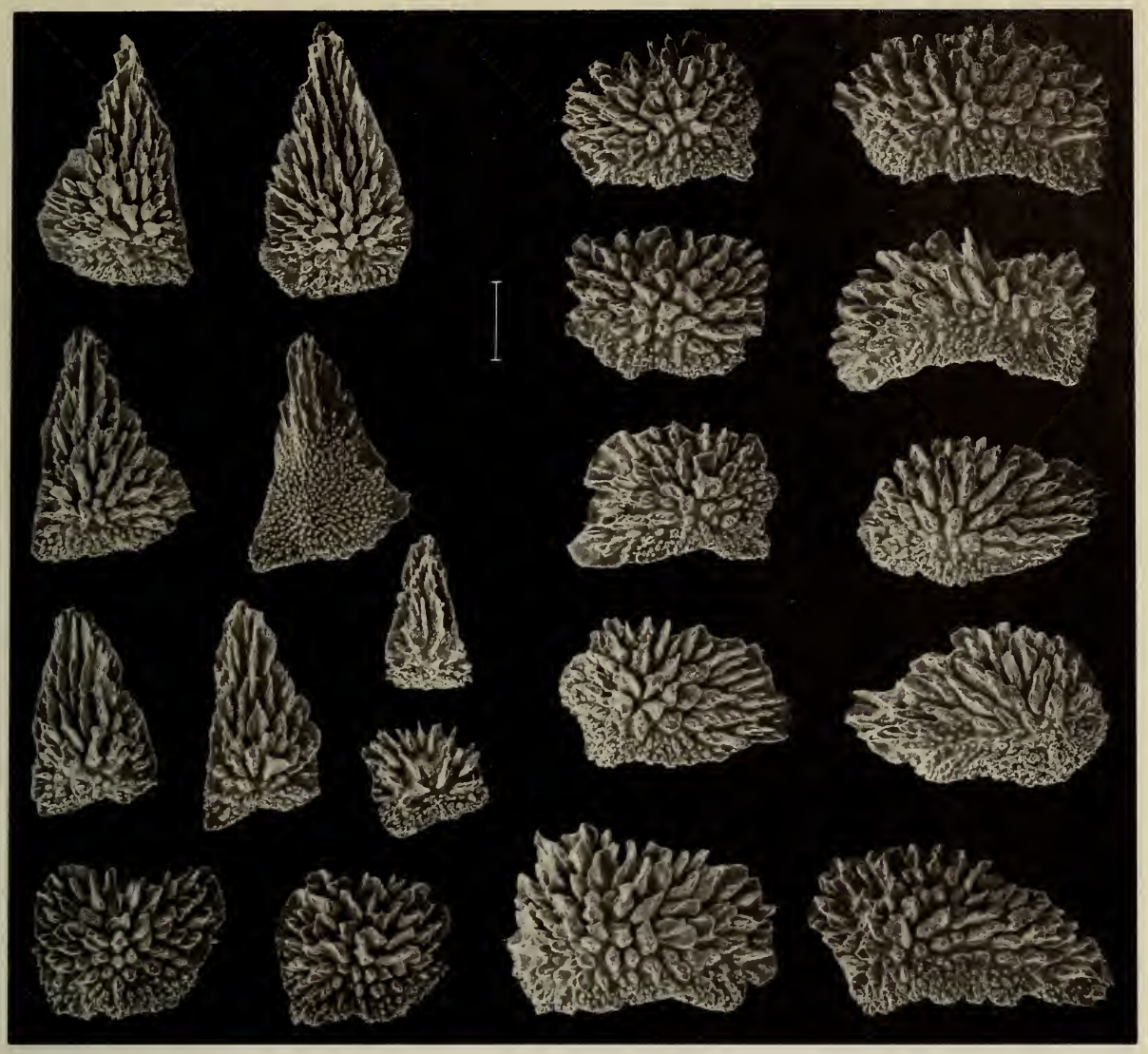


Fig. 20. *Fanellia tuberculata* (Versluys) from Hawaii, USNM 60290: opercular, adaxial marginal, abaxial, and outer-lateral sclerites of polyp. Scale = 0.1 mm.

K. Kinoshita in Zoological Institute, University of Tokyo, USNM 50120.—Kyushu, Kagoshima, 70 fath., 15 July 1899; small branch of colony det. K. Kinoshita in Zoological Institute, University of Tokyo, USNM 60291 (Fig. 25).

*Description.*—Branching quasi-dichotomous or loosely pinnate, alternate, compressed or in one plane. Polyps in whorls of 2 or 3 near tips of terminal twigs, increasing proximally to 5 in some colonies, and as many as 7 or 8 on larger branches, often becoming irregularly scattered; usually 7 or 8 whorls in 1 cm of axial length in the terminal twigs, sometimes as few as 6 or as many as 9. Polyps typically with 6 scales in the abaxial rows, but occasionally as few as 4 and as many as 8; outer lateral rows with 1 or 2 scales; inner lateral rows with only 1 and this may be absent on one or both sides, its place occupied by wide lateral extension of the outer-lateral scale (OL-1); OL-2 if present may extend laterally as a curved lobe beneath the inner-lateral marginal, but a separate second inner lateral (IL-2) has not been observed; 1–3 small scales, commonly 1 or 2, in the adaxial rows beneath the adaxial operculars. Tentacles without sclerites. Coe-

Fig. 21. *Fanellia tuberculata* (Versluys) from Marshall Islands, USNM 44089, holotype of *Callogorgia pseudoflabellum* Bayer: top, whorl of polyps, ×44; bottom, lateral view of polyp, ×56. SEM stereo pairs.

nenchyme covered with closely fitted, rounded-polygonal plates. All sclerites sculptured externally by closely placed, serrated, fluted or ridged tubercles aligned in rows radiating outward from the depositional center ("nucleus"), internally by crowded, complex tubercles.

*Comparisons.*—Kinoshita (1908a:40) remarked upon the similarity of his *Caligorgia aspera* to *C. tuberculata* Versluys, but justified its status as a distinct species on the basis of differences in the form of the external warts of the scales, and on the absence of the sterile twig tips reported in *C. tuberculata* by Versluys (1906:80). These sterile tips are of inconsistent occurrence in Hawaiian material,

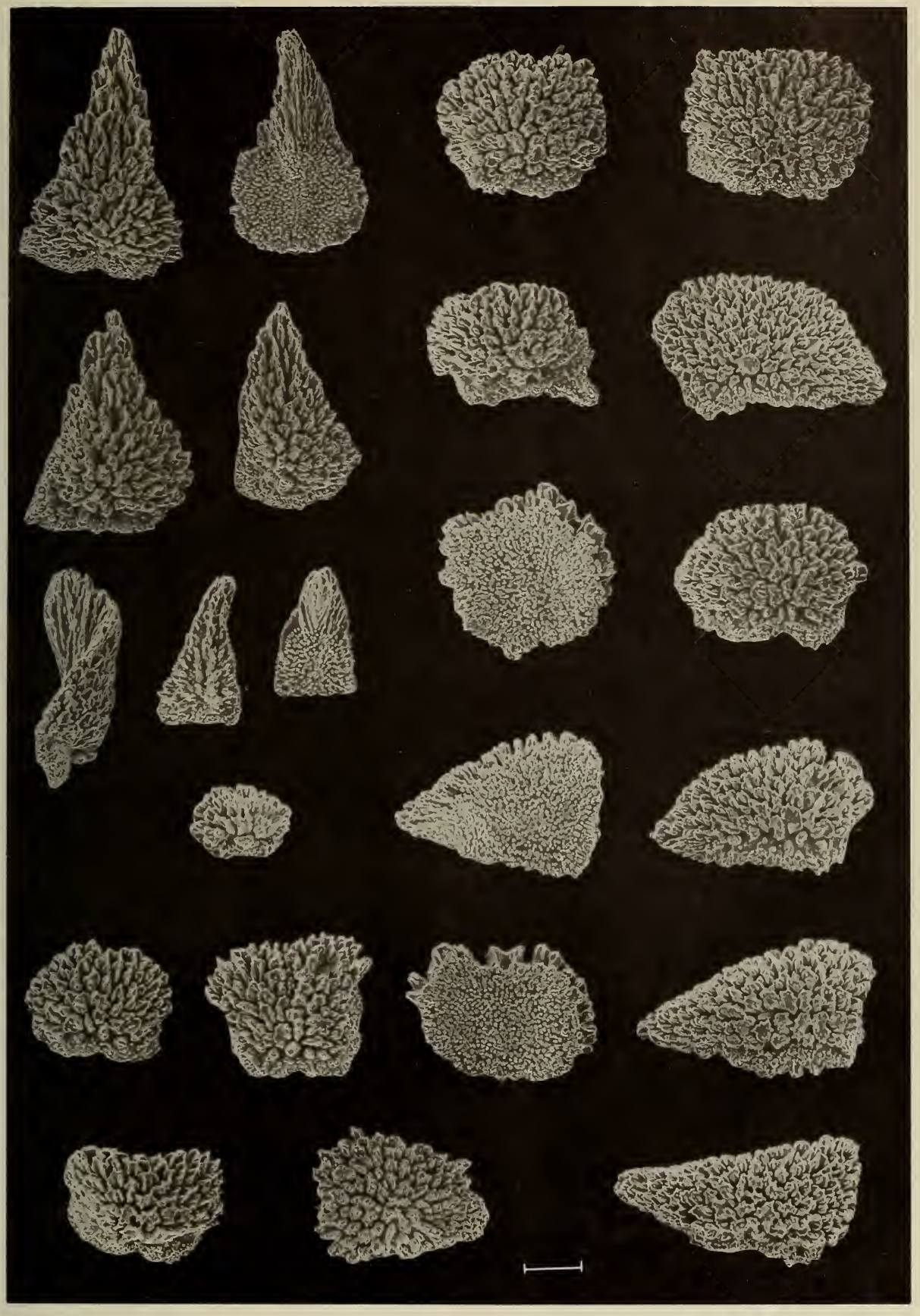


Fig. 22. *Fanellia tuberculata* (Versluys) from Marshall Islands, USNM 44089, holotype of *Callogorgia pseudoflabellum* Bayer: opercular, adaxial marginal, abaxial and outer-lateral sclerites of polyp. Scale = 0.1 mm.

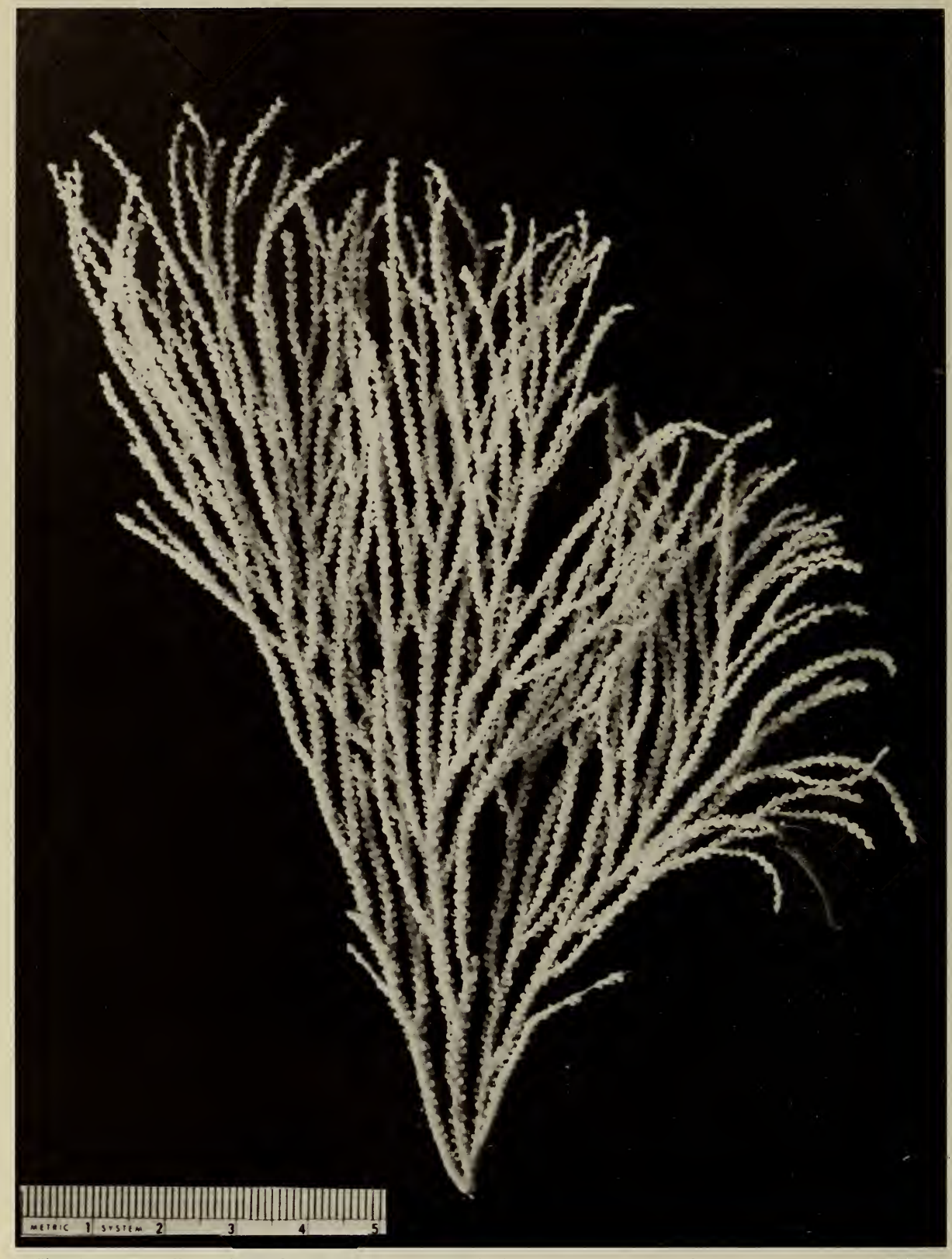



Fig. 23. *Fanellia tuberculata* (Versluys), quasi-dichotomous colony from Japan, USNM 49582. Scale in cm.

but it is not possible to determine whether they are present in some colonies but not in others, because the material was so badly broken during collection. Some of the specimens with sterile branch tips are infested with colonies of a thecate hydroid which seem to grow only on these sterile tips, but I cannot determine

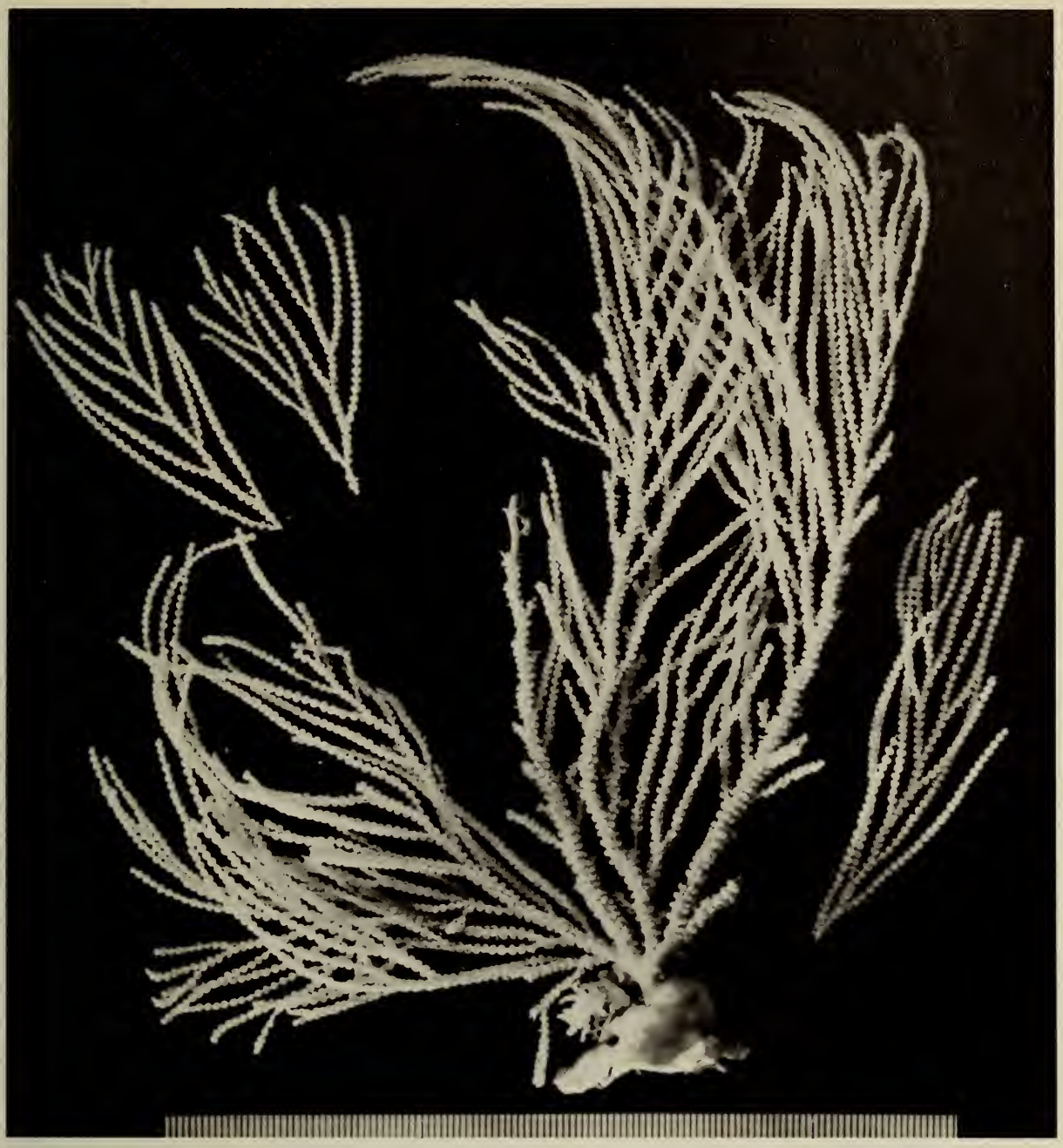


Fig. 24. *Fanellia tuberculata* (Versluys), loose pinnate colony from Japan, USNM 30029. Scale divisions are mm.

whether the hydroids stimulate their production. Such branch tips are not present in any of the Japanese specimens examined.

It should be noted that Nutting (1912:60, 61) reported two specimens from one and the same *Albatross* station, probably parts of one colony, as two different species, *Caligorgia flabellum* (wrongly attributed to Kölliker) and *C. aspera* Kinoshita, the former described as "regularly alternate," the latter as "dividing dichotomously."

Although the holotype colony of *Caligorgia pseudoflabellum* is pinnately branched (Bayer 1949:207), the branchlets are widely spaced as well as further subdivided, and the main axis bends slightly away from the branch at each node, resulting in a loose pinnate pattern that can easily pass for dichotomous. This is

Fig. 25. *Fanellia tuberculata* (Versluys) from Japan; original material of *C. aspera* determined by Kinoshita, USNM 60291. Right and left lateral views of polyps. SEM stereo pairs, ×56.

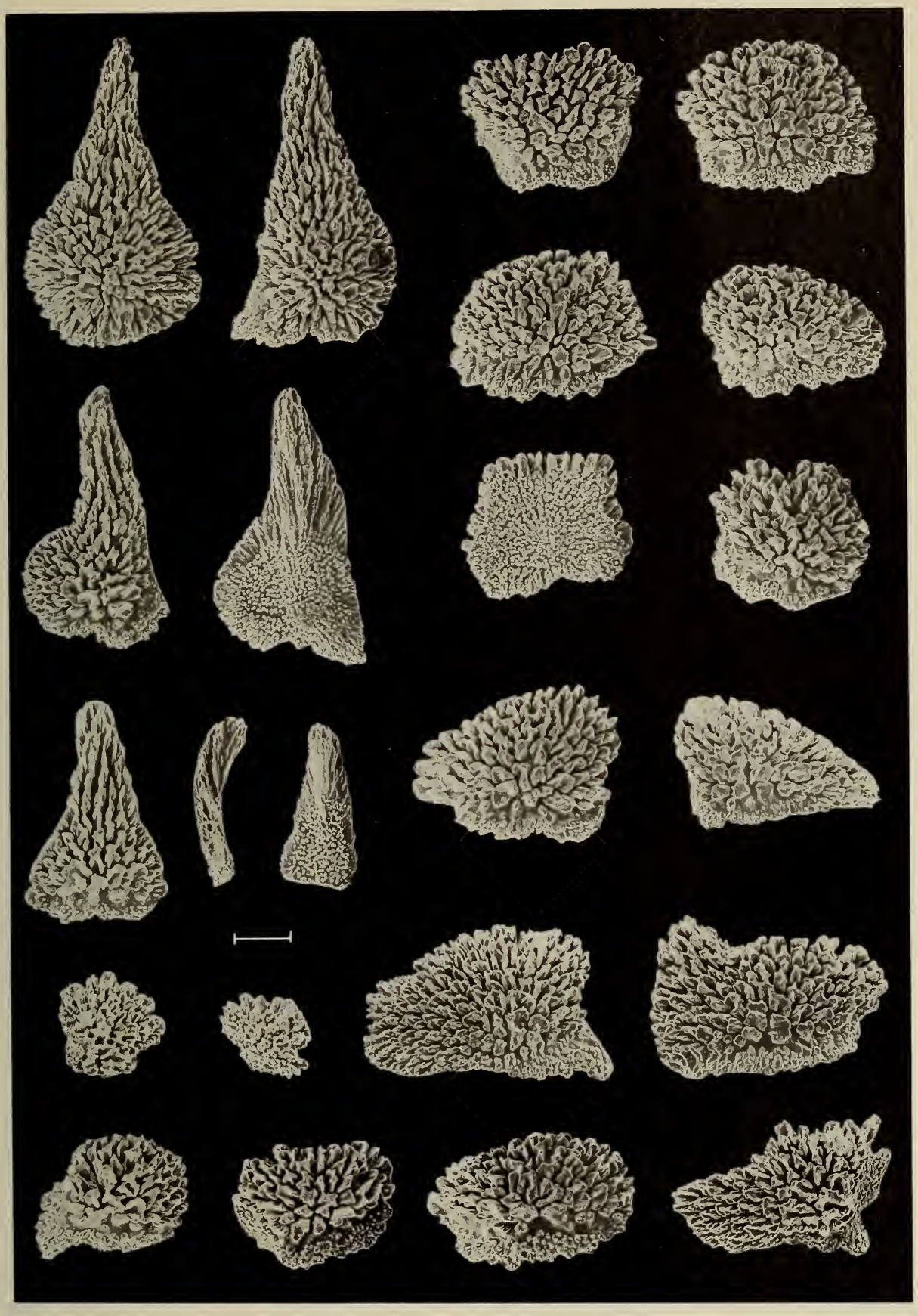


Fig. 26. *Fanellia tuberculata* (Versluys) from Japan, USNM 30029: opercular, adaxial marginal, abaxial, and outer-lateral sclerites of polyp. Scale = 0.1 mm.

clearly seen in the photograph (Bayer 1949: pl. 4, fig. 2), in which the distalmost part of the right-hand fragment would justifiably be described as dichotomous if it were broken off from the lower part. As this growth form does not differ significantly from that illustrated for *C. aspera* by Kinoshita (1908a: pl. 2, figs. 15, 16), and as Kinoshita observed that "die junge Kolonie sowohl als der Stammabschnitt der erwachsenen sind beinahe federartig verzweigt" it is evident that this character is unreliable. The distribution of the polyps and the arrangement of their body sclerites are in such close agreement in *C. tuberculata, C. aspera, C. granulosa,* and *C. pseudoflabellum* that it is probable all four nominal taxa belong to a single species. Although no authentic material of *C. granulosa* has been available to me for examination, the specimen from *Albatross* sta. 4936 off Kyushu (Fig. 24) is loosely pinnate and approaches (but does not duplicate) the close-pinnate form originally described for that species. However, on the strength of existing data, this specimen must be referred to as *C. aspera,* leaving *C. granulosa* as a distinct nominal taxon pending detailed study.

*Distribution.*—Sulu Archipelago, Japan, Marshall Islands, Hawaii.

### *Fanellia corymbosa,* new species
Figs. 27–29

*Material examined.*—One colony, broken in several pieces: Moluccas, off Doworra Island, 0°50′00″S, 128°12′E, 205 fath. (375 m), coral sand; *Albatross* sta. D5629, 2 December 1909. Holotype colony, USNM 50146.

*Description.*—Branching irregularly dichotomous, not in one plane, producing colonies of corymbose form (Fig. 27). Polyps in pairs, the individuals opposite or slightly offset, infrequently in whorls of 3 even on the larger branches; polyps irregularly scattered on the largest branches, absent from the side opposite the direction in which the branchlets grow; 6 or 7 pairs or whorls in 1 cm of branchlet. Branches stiff and rather brittle, the terminal branchlets commonly 10 mm long or less, and 0.75 mm in diameter (exclusive of polyps), with the axis 0.3–0.4 mm in diameter proximally, tapering to a rather coarse point. Diameter of the largest main stem about 3.5 mm exclusive of cortex; axis heavily calcified, brittle, surface inconspicuously grooved longitudinally, appearing nearly smooth, distally creamy yellow with golden iridescence, proximally brown with bronzy gloss.

Polyps (Fig. 28) with only the 2 abaxial rows of sclerites well developed, 5 or 6 thick plates in each, the boundary between proximal abaxial and cortical plates difficult to determine; one wide lateral scale in marginal position on both sides, bearing the outer-lateral and inner-lateral opercular scales; occasionally the lateral marginal plate is divided into two, thus representing outer-lateral and inner-lateral plates; one or two (usually one) small adaxial scale beneath each adaxial opercular, but the remaining adaxial surface of the polyps naked. Body plates (Fig. 29) thick, the external tubercles near the distal margin forming blunt dentations that interlock with the proximal tubercles of the following sclerite, inner surface covered with fine, complex tubercles; opercular scales triangular, the laterals only slightly asymmetrical, the adaxials somewhat smaller than the others but not markedly different in shape; on the inner surface of the operculars a low, strong longitudinal ridge extends from center to apex, most prominent on the dominant abaxial, progressively smaller on the outer and inner laterals and adax-

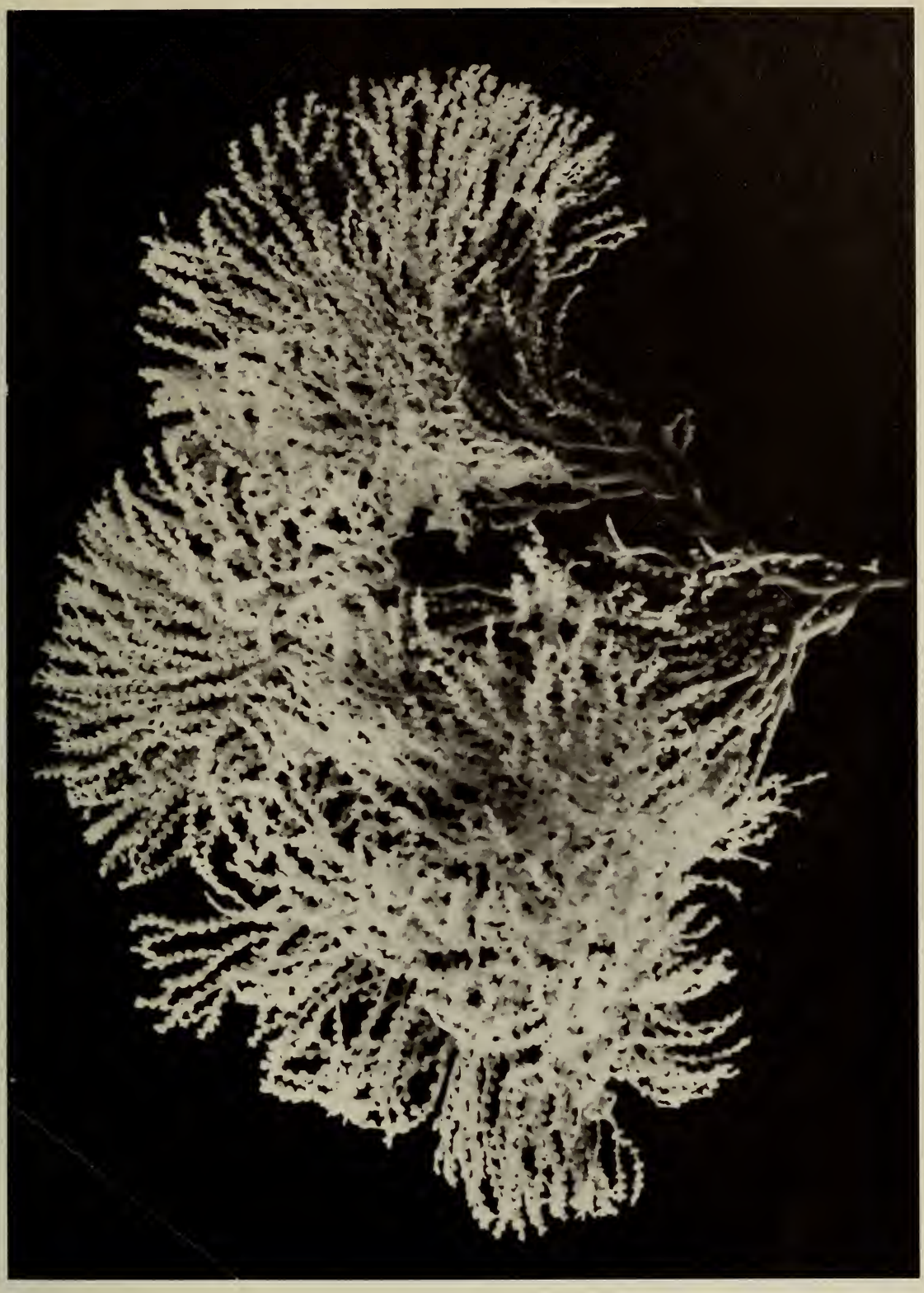


Fig. 27. *Fanellia corymbosa,* new species; holotype colony, USNM 50146. Width 35 cm.

ials; outer surface convex, a prominent rounded boss at the nucleus, covered with closely set hemispherical tubercles that become lower and less prominent toward the edges and elongated in shape toward the apex of the scale. Tentacles without sclerites.

Coenenchymal sclerites rounded or spheroidal pebbles with hemispherical tu-

Fig. 28. *Fanellia corymbosa,* new species; holotype, USNM 50146: abaxial and right lateral views of polyp. SEM stereo pairs, ×45.

bercles on outer surface, finer complex tubercles on inner surface; largest sclerites become thick, irregular bodies resembling coarse cobblestone pavement.

*Comparisons.*—In many ways, this species resembles Kinoshita's *Callogorgia aspera* and *C. granulosa,* the first definitely and the second possibly a synonym of *Fanellia tuberculata* (Versluys), but differs from both in growth form. *F. tuberculata,* from the Sulu Archipelago, usually has 2 plates in the outer-lateral rows and 1 in the inner-lateral rows, whereas *F. corymbosa* has only a single outer-lateral plate on each side, extending into the inner-lateral position where no separate plate is developed. The lower abaxial plates of *corymbosa* are much wider (to 0.6 mm) than those of *tuberculata* (0.3–0.4 mm). No sterile terminal branch tips were observed in *corymbosa.*

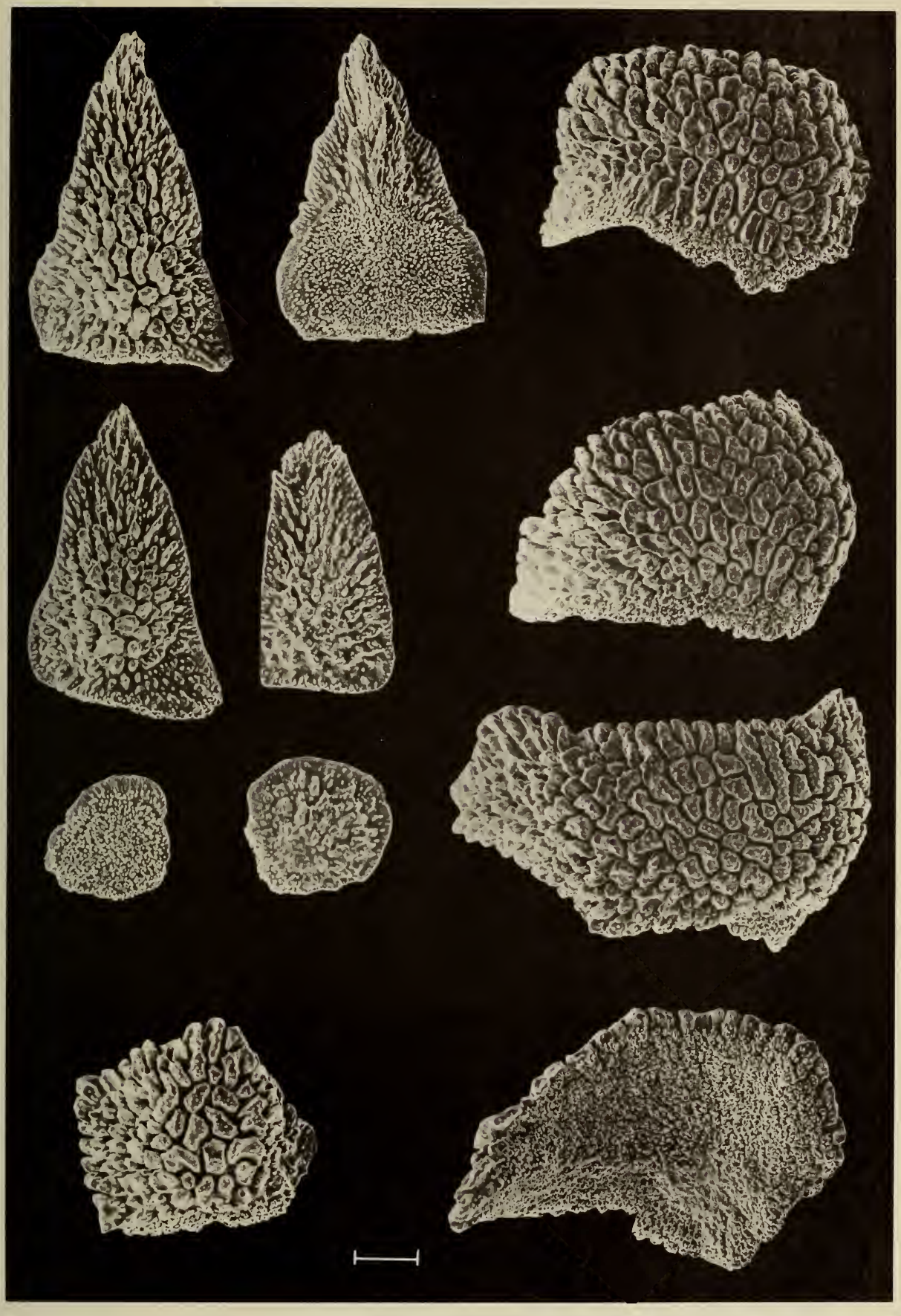


Fig. 29. *Fanellia corymbosa,* new species; holotype, USNM 50146: opercular, abaxial marginal and abaxial proximal body sclerites. Scale = 0.1 mm.

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Department of Invertebrate Zoology, Smithsonian Institution, Washington, D.C. 20560.